FLOOD INSURANCE STUDY

VOLUME 1 OF 2

MENDOCINO COUNTY, CALIFORNIA,
AND INCORPORATED AREAS

Community Name	Community Number
FORT BRAGG, CITY OF	060184
MENDOCINO COUNTY	060183
PINOLEVILLE INDIAN RESERVATION (UNINCORPORATED AREAS)	060058
UKIAH, CITY OF	060186
WILLITS, CITY OF	060187

Revised:

PRELIMINARY
MONTH XX, XXXX

Federal Emergency Management Agency

FLOOD INSURANCE STUDY NUMBER
06045CV001B

NOTICE TO
FLOOD INSURANCE STUDY USERS

Communities participating in the National Flood Insurance Program have established repositories of flood hazard data for floodplain management and flood insurance purposes. This Flood Insurance Study may not contain all data available within the repository. It is advisable to contact the community repository for any additional data.

Part or all of this Flood Insurance Study may be revised and republished at any time. In addition, part of this Flood Insurance Study may be revised by the Letter of Map Revision process, which does not involve republication or redistribution of the Flood Insurance Study. It is, therefore the responsibility of the user to consult with community officials and to check the community repository to obtain the most current Flood Insurance components.

This FIS report was revised on Month XX, XXXX. Users should refer to Section 10.0, Revisions Description, for further information. Section 10.0 is intended to present the most up-to-date information for specific portions of the FIS report. Therefore, users of the FIS report should be aware that the information presented in Section 10.0 supersedes information in Sections 1.0 through 9.0 of this FIS report.

Selected Flood Insurance Rate Map (FIRM) panels for this community contain information that was previously shown separately on the corresponding Flood Boundary and Floodway Map (FBFM) panels (e.g., floodways, cross sections). In addition, former flood hazard zone designations have been changed as follows:

Old Zone(s)	New Zone
Al through A30	AE
B	X
C	X

Initial Countywide FIS Effective Date: June 2, 2011

Revised Countywide Dates: Month XX, XXXX

TABLE OF CONTENTS – Volume 1

FIGURES

TABLE OF CONTENTS – Volume 1– continued

TABLES

TABLE OF CONTENTS – Volume 2

EXHIBITS

FLOOD INSURANCE STUDY
MENDOCINO COUNTY, CALIFORNIA
AND INCORPORATED AREAS

1.0 INTRODUCTION

1.1 Purpose of Study

This Flood Insurance Study (FIS) revises and supersedes the FIS reports and/or Flood Insurance Rate Maps (FIRMs) in the geographic area of Mendocino County, California, including the Cities of Fort Bragg, Point Arena, Ukiah, and Willits; the Pinoleville Indian Reservation; and the unincorporated areas of Mendocino County (hereinafter referred to collectively as Mendocino County), and aids in the administration of the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. This study has developed flood-risk data for various areas of the community that will be used to establish actuarial flood insurance rates. This information will also be used by Mendocino County to update existing floodplain regulations as part of the Regular Phase of the National Flood Insurance Program (NFIP), and by local and regional planners to further promote sound land use and floodplain development. Minimum floodplain management requirements for participation in the NFIP are set forth in the Code of Federal Regulations at 44 CFR, 60.3.

In some states or communities, floodplain management criteria or regulations may exist that are more restrictive or comprehensive than the minimum Federal requirements. In such cases, the more restrictive criteria take precedence and the State or other jurisdictional agency will be able to explain them.

1.2 Authority and Acknowledgments

The sources of authority for this FIS are the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973.

Information on the authority and acknowledgements for each of the previously printed FISs and FIRMs for communities within Mendocino County was compiled, and is shown below.

Fort Bragg, City of	The hydrologic and hydraulic analyses for the June 16, 1992 study (FEMA, 1992(a)) were performed by Philip Williams and Associates, for the Federal Emergency Management Agency (FEMA), under Contract No. EMW-89-C-2845. This study was completed in September 1990.

Mendocino County (Unincorporated Areas)	The hydrologic and hydraulic analyses for the original June 1, 1983 study were performed by Anderson-Nichols and Company, Inc., for FEMA, under Contract No. H-4821. This work was completed in March 1981. In the 1986 revised study, flood hazard analyses for Gualala River were performed by Ott Water Engineers, Inc., for FEMA, under Contract No. EMW-83-C-1175. This work was completed in August 1984. The study was also revised on September 30, 1988, to reflect changes in the floodplain boundary, floodway, and base (1-percent-annual-chance) flood elevations along Baechtel Creek downstream (east) of the Southern Pacific Railroad crossing. These changes were based on new topographic mapping that is more detailed and more accurate than that used in the original FIS report for Mendocino County. The study was again revised on June 16, 1992, to incorporate a detailed hydrologic and hydraulic analysis of the base flood along the Noyo River from 480 feet downstream of Highway 1 to 7,240 feet upstream of Highway 1. The new analysis was conducted by Phillips Williams and Associates, Ltd., for FEMA under Contract No. EMW 89-C-2845. The work was completed in January 1991. (FEMA, June 1992 (b)).
Point Arena, City of	The coastal hazard analyses for the June 3, 1986, study (FEMA, 1986) were performed by Ott Water Engineers, Inc., for FEMA, under Contract No. EMW-83-C-1175. This work was completed in August 1984.
Ukiah, City of	The hydrologic and hydraulic analyses for the original study were performed by Anderson-Nichols & Company, Inc., for FEMA, under Contract No. H-4821. This study was completed in April 1981. An August 5, 1985 revised hydraulic analysis (FEMA, 1985) was performed for Orrs Creek between U.S. Highway 101 and Ford Street. This work was completed in June 1984.

Willits, City of	The hydrologic and hydraulic analyses for the September 30, 1988 study (FEMA, 1988(a)) were performed by Anderson-Nichols and Company, Inc., for the FEMA, under Contract No. H-4821. This work was completed in April 1981. Updated hydrologic and hydraulic analyses for the City of Willits and the Little Lake Valley area are discussed in Section 10.1 as part of the Month XX, XXXX Physical Map Revision.

No previous report was prepared for the Pinoleville Indian Reservation.

For the first time countywide FIS, MAPI-X compiled the existing data to convert the previous Mendocino County FIS into digital format. In addition, MAP-IX added 72 miles of approximate study along the Eel River and its tributaries. MAPIX completed this work in March 2009 under Contract No. EMF-2003-CO-0047.

Base map information shown on select FIRMs was derived from multiple sources. This information was compiled from the U.S. Geological Survey (USGS), 1989 and 1997, National Atlas, 2000 and 2002, National Geodetic Survey, 2005, Mendocino County GIS, 2007, and U.S Census Bureau, 2006. Additional information was photogrammetrically compiled at a scale of 1:12,000 from U.S. Department of Agriculture aerial photography dated 2014. Basemap information shown on the Month XX, XXXX FIRMs was derived from Mendocino County GIS, 2014, and U.S. Department of Commerce, 2014.

The projection used in the preparation of this map was UTM, Zone 10 N. The horizontal datum was NAD83, GRS80 spheroid. Differences in datum, spheroid, projection or State Plane zones used in the production of FIRMs for adjacent jurisdictions may result in slight positional differences in map features across jurisdiction boundaries. These differences do not affect the accuracy of this FIRM.

1.3 Coordination

An initial Consultation Coordination Officer's (CCO) meeting was held with representatives from FEMA, the community, and the study contractor to explain the nature and purpose of a FIS, and to identify the streams to be studied by detailed methods. A final CCO meeting was held with representatives from FEMA, the community, and the study contractor to review the results of the study. All problems raised in the meeting have been addressed in this study.

The dates of the initial and final meetings held for Mendocino County and its incorporated communities are listed in Table 1, "Initial and Final CCO Meetings."

Table 1 – Initial and Final CCO Meetings

COMMUNITY NAME	INITIAL MEETING	FINAL MEETING
Fort Bragg, City of	September 9, 1990	August 7, 1991
Mendocino County (Unincorporated Areas)[1]	July 1978 May 1983 (1986 Revision)	July 21, 1982 *
Point Arena, City of	May 1983	*
Ukiah, City of	July 1978	*
Willits, City of	July 6, 1978	August 25, 1981
Willits, City of	*	Month XX, XXXX

* Data Not Available

[1] CCO meeting data not available for the 1988 or 1992 revisions

For the countywide revision, an initial CCO meeting was held on December 13, 2006, and was attended by representatives of the community, the study contractor and FEMA. The final CCO meeting was held on June 3, 2009, and was attended by representatives of the community, the study contractor and FEMA.

2.0 AREA STUDIED

2.1 Scope of Study

This FIS covers the geographic area of Mendocino County, California. All or portions of the flooding sources listed in Table 2, "Detailed Studied Streams," were studied by detailed methods. Limits of detailed study are indicated on the Flood Profiles (Exhibit 1) and on the FIRM (Published Separately).

Table 2 – Detailed Studied Streams

Ackerman Creek	Mill Creek (at Redwood Valley)
Anderson Creek	Mill Creek (at Willits)
Broaddus Creek	Mill Creek (near Talmage)
Davis Creek	North Fork Mill Creek
Doolin Creek	Noyo River
East Fork Russian River	Orrs Creek
Eel River	Robinson Creek
Feliz Creek	Russian River
Forsythe Creek	Sulphur Creek
Gibson Creek	Tenmile Creek
Haehl/Baechtel Creek	Town Creek
Hensley Creek	York Creek

Flooding on Mendocino Creek, a tributary to Doolin Creek, within the corporate limits was studied by approximate methods. However, analyses showed that the 1-percent-annual-chance floodplain on Mendocino Creek was consistently less than 200 feet wide. Therefore, the area was designated a zone of minimal flood hazards.

Flooding caused by Baechtel Creek, Haehl Creek, Mill Creek, and Broaddus Creek was studied in detail. Specifically, Baechtel Creek was studied from approximately 60 feet downstream of the U.S. Highway 101 bridge to its confluence with Haehl Creek. The detailed study area of Haehl Creek consisted of the study reach between the confluence with Baechtel Creek and the downstream corporate limits on the north side of the city. For the purposes of this study, the detailed study streams of Haehl and Baechtel Creeks are considered to be one stream downstream of their confluence and are hereafter called Haehl/Baechtel Creek in this report. Mill Creek was studied from the upstream community boundary on the west side of the city to the downstream community boundary at the north end of Willits. Broaddus Creek was studied from approximately 140 feet downstream of the Flower Street bridge to its confluence with Haehl/Baechtel Creek.

Detailed studies were terminated on streams having drainage areas less than 1 square mile or where the 1-percent-annual-chance floodplain was less than 200 feet wide. For Laytonville Creek, the drainage area was found to be less than 1 square mile above the confluence with Tenmile Creek. For this reason, Laytonville Creek was not studied. The detailed study of Mill Creek (near Talmage) was terminated 120 feet downstream of the Mill Creek Road bridge, where the 1-percent-annual-chance floodplain narrowed to less than 200 feet wide.

Approximate analyses were used to study those areas having a low development potential or minimal flooding hazards. The scope and methods of study were proposed to, and agreed upon, by FEMA and the communities.

Table 3, "Letters of Map Change," presents Letters of Map Change (LOMCs) incorporated into the 2011 countywide study.

2.2 Community Description

Mendocino County is located on the northern coast of California. The county is bordered on the south by Sonoma County; on the east by Lake, Glenn, and Tehama Counties; on the north by Trinity and Humboldt Counties; and on the west by the Pacific Ocean. The total land area of the county is 3,510 square miles. The estimated population in 2010 was 87,869 (U.S. Census Bureau, 2015).

Table 3 – Letters of Map Change

Case Number	Communities	Old Panel(s)	New Panel(s)
00-09-0219P	Mendocino County (Unincorporated Areas)	0601830803B 0601830811B	06045C1516F
00-09-382P	City of Ukiah, Mendocino County	0601860002D	06045C1514F
03-09-0317P	City of Ukiah, Mendocino County	0601830803B 0601830811B	06045C1512F
92-09-040P	Mendocino County (Unincorporated Areas)	0601830601B 0601830782B 0601830784B 0601830801B 0601830803B	06045C1504F 06045C1508F

The climate of Mendocino County varies with distance from the moderating effects of the Pacific Ocean. Along the coast, the climate is west coast Mediterranean with summer temperatures cooled by ocean fog. Inland, the summer fog disappears, the annual rain-fall increases with elevation, and the temperature extremes increase in both summer and winter. The average maximum summer coastal temperature is around 65°F while 30 miles inland the average summer maximum is around 90°F. The inland portion of the county can thus be classified as a Mediterranean, warm summer climate (Felton, 1965). Throughout the county, winters are cool and wet, with some snow at higher elevations. Over 75 percent of the total annual precipitation occurs between November and March. The mean annual precipitation for the county is 50 inches.

The economy of Mendocino County is heavily dependent on agriculture and logging. Along the coast and in the Russian River valley is primarily where agricultural development can be found. Orchards and vineyards cover the valley floor. Most of the county is rugged, hilly, and mountainous terrain, forested with coastal redwoods, pines, and Douglas fir. There is considerable commercial logging and associated lumber mill activity. Residential and commercial development in the county is concentrated along State Highway 1 along the coast and U.S. Highway 101 inland. U.S. Highway 101 runs parallel to the Russian River for much of its length and is the major north-south transportation route through the county. The highway connects the communities of Ukiah and Willits (the two largest cities in Mendocino County) and is the most convenient access to the detailed-study areas.

<u>City of Fort Bragg</u>
Fort Bragg is located near the mouth of the Noyo River in Mendocino County. The city is approximately 170 miles north of San Francisco. It is the largest town between San Francisco and Eureka. Noyo Harbor is one of only

two harbors of refuge along approximately 300 miles of coastline from Humbolt Bay on the north to Bodega Bay on the south (Noyo Port District, 1989). Noyo Harbor is located approximately 1.5 miles south of the central business district.

The unincorporated Town of Noyo (essentially the harbor) is adjacent to Fort Bragg. It was established with the construction of a sawmill in 1852, and a few years later a rail link to the interior made the Noyo-Fort Bragg area an important logging center. The fishing industry developed around the natural harbor at Noyo and the first commercial catch was shipped in 1915.

The natural harbor had a sandbar partially blocking the river mouth, reducing the entrance to 20 feet wide by 1 foot deep at low water. Lumber schooners loaded within the river could only leave during the months when winter rains made navigation conditions most favorable. In 1932, the channel mouth had been dredged to provide 10 feet deep by 100 feet wide entrance channel and the river channel was dredged to 150 feet wide for 0.6 mile upstream. Since this time two jetties were constructed and additional dredging has been done to create boat basins. Maintenance dredging, which during the 1930s was approximately 4,000 cubic yards per year, increased more than five-fold over 20,000 cubic yards per year during the 1960s. Recent dredging has increased the depth of the harbor to over 15 feet below Mean Low Low Water in some areas (USACE, August 1975).

The Noyo River watershed is approximately 114 square miles. There are no dams or diversions on the Noyo River.

Noyo Harbor is home to about 250 full-time commercial fishing boats, with an additional 200 boats during the peak fishing season. More than 1/2 the businesses in the harbor are related to commercial fishing and about 1/3 are recreation and tourism (Noyo Port District, 1989).

Mendocino County (Unincorporated Areas)

The Russian River originates in central Mendocino County, flows south through the Ukiah Valley, enters Sonoma County, and turns west to flow into the Pacific Ocean. The drainage area of the watershed at the downstream end of the detailed-study area is 437 square miles – approximately one-eighth of the county land area.

Forsythe Creek, like many of the other detailed-study streams, lies within the Russian River watershed. The stream is 12.5 miles long and has a drainage area of 49.7 square miles at its confluence with the Russian River. Mill Creek (at Redwood Valley) – one of several Mill Creeks within the county – is a tributary to Forsythe Creek. Mill Creek (at Redwood Valley) has a tributary area of 11.4 square miles at its downstream confluence and is 8.5 miles long.

North of the City of Ukiah, York, Hensley, and Ackerman Creeks all flow into the Russian River after originating in the mountains to the west of the Ukiah Valley. York Creek is 8 miles long and has a watershed area of 12.0 square miles at its confluence with the Russian River. Hensley Creek is 7 miles long and has a drainage area of 7.6 square miles where it joins the Russian River. Ackerman Creek is 11 miles long and has a drainage area of 20.6 square miles at its confluence with the Russian River.

Orrs Creek flows easterly and is the largest stream traversing the City of Ukiah. Paralleling it to the south are the two other principal streams, Gibson and Doolin Creeks. Orrs Creek has a drainage area of 10.2 square miles. This watershed, approximately 8 miles in length, ranges in elevation from 3,400 feet at its upper end to approximately 595 feet at its confluence with the Russian River at the eastern corporate limits of Ukiah (Towill Corporation, September 1979(b)). Gibson Creek, a tributary to Doolin Creek, is 5 miles long and has a drainage area of 2.9 square miles. Doolin Creek is 4 miles in length and has a total drainage area of 7.2 square miles, including the tributary area of Gibson Creek (USGS, 1958).

The East Fork Russian River in Potter Valley is 8 miles long and has a drainage area of 29.1 square miles at its downstream study limit. The East Fork Russian River also receives water from the hydroelectric power diversion on the Eel River at the Van Arsdale Reservoir. Approximately 300 cubic feet per second (cfs) enter the East Fork Russian River from the Eel River Diversion.

The Eel River near Van Arsdale Reservoir is approximately 30 miles long and has a drainage area of 353 square miles at its confluence with Hale Creek. As noted above, 300 cfs is diverted at the reservoir for hydroelectric power, and this diverted flow is then released into the East Fork Russian River.

South of the City of Ukiah in the Russian River Valley, Mill Creek (near Talmage), Robinson Creek, and Feliz Creek enter the Russian River. Mill Creek (near Talmage) has its headwaters in the hills on the eastern side of the valley. Mill Creek (near Talmage) is 6 miles long and has a drainage area of 18.0 square miles at its downstream confluence with the Russian River. North Fork Mill Creek is a major tributary, has a drainage area of 5.3 square miles when it joins Mill Creek (near Talmage), and is 4 miles long. Robinson Creek drains 26.7 square miles of the western side of the valley before joining the Russian River and is 8 miles long. Feliz Creek, near Hopland, also has its origin in the mountains to the west of the Russian River Valley. Feliz Creek is 11 miles long and has a drainage area of 433 square miles at its confluence with the Russian River.

Anderson Creek, near Boonville in the Anderson Valley, is a tributary of the Navarro River. Anderson Creek is 10 miles long and has a drainage area of 35.4 square miles at its downstream study limit.

Tenmile Creek, near Laytonville, is a tributary of the South Fork Eel River. Tenmile Creek is 7 miles long, from its headwaters to the downstream end of the detailed-study area, and has a drainage area of 20.9 square miles.

Town Creek, near Covelo in Round Valley, is a tributary of Grist Creek, which in turn joins Mill Creek (at Round Valley). Mill Creek (at Round Valley) then flows into the Middle Fork Eel River. Town Creek is 7 miles long and has a drainage area of 11.3 square miles at its confluence with Grist Creek.

Davis Creek is located east of the City of Willits and flows along the eastern side of Little Lake Valley. Davis Creek is 8 miles long from its headwaters to the downstream end of the detailed-study area and has a drainage area of 14.8 square miles.

The Gualala River enters the Pacific Ocean adjacent to the unincorporated Town of Gualala. A low-lying sand spit has formed at the mouth of the river along the southwest bank. Buildings and residences in Gualala skirt State Highway 1 at an elevation of 40 feet or greater. The milling of lumber provides the economic base for the small population that resides there. Development within the floodplain is nearly nonexistent except for a 2,400-foot length of State Highway 1. A recreational housing development consisting of summer homes and trailer hookups was proposed for an area of the floodplain west of State Highway 1 and east of the Gualala River (Ott Water Engineers, Inc., August 1984).

<u>City of Point Arena</u>
The City of Point Arena is located along the southwestern coast of Mendocino County, in northwestern California. The city encompasses an area slightly in excess of 1.2 square miles. Point Arena is bordered by the Pacific Ocean to the west and the Unincorporated Areas of Mendocino County to the north, east, and south.

Point Arena is a small coastal fishing community with an estimated 2013 population of 449 (U.S. Census Bureau, 2015). Fishing, tourism, and community services provide the economic base for Point Arena.

Elevations in the city range from sea level to over 280 feet. The community is drained to a great extent by Point Arena Creek, which flows easterly to its mouth at Arena Cove on the Pacific Ocean.

Arena Cove is an area of shallow water with a narrow navigable outlet. The Cove is open to the Pacific Ocean on the West and South sides. Offshore bathymetry to the south, a natural low rock formation to the east, headlands to the North, and rip rap provide protection from moderately high storm generated waves.

A public pier facility, several commercial buildings, and a long abandoned manufactured home are located near the mouth of Point Arena Creek. A wastewater treatment facility owned and operated by the City of Point Arena is located adjacent to Point Arena Creek approximately 0.75 miles inland. Homes, lodging facilities, and other structures built at varying elevations and distances from Arena Creek exist on parcels adjacent to the creek upstream of the Wastewater treatment facility.

City of Ukiah

The City of Ukiah is located in the southeastern part of Mendocino County in the north coast region of California. The city is situated on the west bank of the Russian River and is 120 miles north of San Francisco. The total land area within the corporate limits is approximately 4 square miles. The area surrounding Ukiah is part of unincorporated Mendocino County. The closest incorporated city is Willits, located approximately 20 miles to the north on U.S. Highway 101.

The 2013 estimated population of Ukiah was 15,871 (U.S. Census Bureau, 2015.

As discussed previously Orrs Creek is the largest stream traversing the city. Paralleling it to the south are the two other principal streams, Gibson and Doolin Creeks. All three streams drain into the Russian River.

The Russian River, located along the eastern edge of the community, originates in central Mendocino County, flows south through the Ukiah Valley, enters Sonoma County, and turns west to flow into the Pacific Ocean.

Ukiah is the agricultural and lumber center of the northern end of the Russian River Valley. Development in Ukiah is concentrated along U.S. Highway 101 Business Route (State Street). All three of the studied streams cross the developed area.

Most of the developed land within the city is used for either residential or commercial purposes. Agricultural land (orchards and vineyards) is located in the Russian River floodplain between residential areas and the river.

City of Willits

The City of Willits is located in central Mendocino County, in the north coast region of California. The city is on the western side of Little Lake Valley in the headwaters of Eel River and is 150 miles north of San Francisco. The total land area within the corporate limits is approximately 2 square miles.

The 2013 estimated population of the City of Willits was 4,828 (U.S. Census Bureau, 2015). The area surrounding Willits is part of the Unincorporated Areas of Mendocino County. The closest incorporated city is Ukiah, approximately 20 miles south on U.S. Highway 101.

Mill Creek (at Willits) flows out of the hills to the west of Willits and through the city to the northeast. North of Willits, the creek joins with the other streams of Little Lake Valley to form Outlet Creek. Mill Creek (at Willits) has a drainage area of 9.7 square miles. The watershed, approximately 8 miles in length, ranges in elevation from 2,400 feet at its upper end to 1,350 feet at its lower end in Little Lake Valley (USGS, 1961).

Broaddus Creek enters the city from the west and flows northeasterly through the community to join Haehl/Baechtel Creek near the northern corporate limits. Haehl and Baechtel Creeks flow northerly through Willits (Towill Corporation, September 1979(c)). Broaddus Creek is 6.5 miles in length and has a tributary area of 7.9 square miles. Haehl/Baechtel Creek, including the tributary area of Baechtel Creek (8 miles long, 10.1 square miles), Broaddus Creek, and Mill Creek (at Willits) (for the 2-percent-annual-chance and larger floods), has a drainage area of 33.6 square miles.

Willits is the lumber center of central Mendocino County. Development in Willits is concentrated along U.S. Highway 101 (Main Street). Baechtel, Mill (at Willits), and Broaddus Creeks cross the developed area along U.S. Highway 101. The residential areas in the city are, for the most part, located west of U.S. Highway 101 and out of the floodplain. The majority of the land within the floodplain is agricultural, with some light industry. However, there is increasing pressure to develop this flat, open land.

2.3 Principal Flood Problems

The major floods in unincorporated Mendocino County have resulted from extended periods of winter rainfall produced by storms from the Pacific Ocean. Flooding on several of the streams studied in detail have been extensively documented by gage records, high-water marks, damage surveys, and personal accounts.

Areas of Mendocino County are also subject to flooding from storm tides. There are no National Ocean Survey tide gages in Mendocino County. The nearest long-term tide gages are located at Point Reyes, to the south in Marin County, and Crescent City, to the north in Del Norte County. The highest tide recorded at Point Reyes occurred on February 7, 1978, with a height of 8.3 feet North American Vertical Datum of 1988 (NAVD 88) (12.4 feet above gage datum). The Crescent City tide gage has measured a high tide of 9.8 feet NAVD 88 (13.8 feet above gage datum) on February 4, 1958 (U.S. Department of Commerce, n.d.).

City of Fort Bragg

Flooding in Noyo Harbor can be caused by high river flows and high tides with storm surge. The most destructive flooding which occurred in April 1964 was caused by tsunami and associated tidal surges resulting from the Alaskan earthquake. Heavy rains in January of 1966 caused damage to boats in the harbor, primarily as a result of high velocity river flows carrying large logs and other debris. However, there are no records of flood damage during the maximum recorded river discharge of 26,600 cfs in 1974, almost 50 percent greater than the maximum river flow of 19,200 cfs in 1966.

Mendocino County (Unincorporated Areas)

Two USGS gaging stations are located on the Russian River in the detailed-study area. The station near Hopland (No. 11462500) was originally established in 1939. The largest flood recorded at the gage occurred on December 22, 1955, with a measured peak discharge of 45,000 cfs and an estimated recurrence interval of 46 years.

Regulation of the Russian River streamflow since 1958 with the construction of Coyote Dam (Lake Mendocino) on the East Fork Russian River has reduced the peak discharge. The largest flood recorded since 1958 occurred on December 22, 1964, with a measured peak discharge of 41,500 cfs and an estimated recurrence interval of 32 years. The only other large flood to occur since 1958 was on January 16, 1974, with a peak discharge of 39,700 cfs and an estimated recurrence interval of 25 years.

The USGS gaging station near the City of Ukiah (No. 11461000) has recorded discharges on the Russian River during 1911-1913, 1952-1972 (0.6 mile upstream of Lake Mendocino Drive), and 1971-present (at Lake Mendocino Drive). The largest flood recorded at the gage occurred on December 21, 1955, with a measured peak discharge of 18,900 cfs and an estimated recurrence interval of 36 years. Other large floods measured at the gage are as follows:

Date	Discharge (cfs)	Recurrence Interval (Years)
December 22, 1964	17,900	25
January 16, 1974	15,600	13
November 6, 1912	13,600	7

Flood stages and discharges have been measured on the Eel River at Van Arsdale Reservoir (USGS gaging station No. 11471500) since 1910. The three largest floods measured are as follows:

Date	Discharge (cfs)	Recurrence Interval (Years)
December 22, 1964	64,100	44
December 22, 1955	48,600	18
December 11, 1937	44,100	14

The assignment of recurrence intervals to the discharges of historical floods on the Russian and Eel Rivers is of value as a rough comparison between the 1-percent-annual-chance flood presented in this study and actual floods experienced on the river. However, recurrence intervals assigned on the basis of discharges measured at a gage may not be applicable to flood elevations observed away from the gaging site. The recurrence intervals presented above are based on the data analyses performed at the time the original study was published and will change as more data become available.

The USGS operated a streamflow gage (No. 11462700) on Feliz Creek from 1958 to 1966. The largest flood during this period of record occurred on December 22, 1964, with a peak discharge of 6,080 cfs. Because of the short period of record (8 years), no recurrence interval has been assigned to this flood.

The U.S. Army Corps of Engineers (USACE) collected and tabulated high-water marks from the 1964 flood (USACE, n.d.(b); USACE, n.d.(c); and USACE, December 1965). The locations and elevations of some of these marks are shown in Table 4, "High-Water Mark Elevations".

High-water mark data in the detailed-study area of the Eel River were not available.

Several publications have described the floods of December 1955 and December 1964 in the Russian and Eel River watersheds (State of California, January 1965; USACE, June 1956; USACE, January 1965, Winsler Kelly Consulting Engineers, May 1970; and USGS, 1969). Damage estimates for the 1955 flood in the Russian River valley amounted to over $5 million for the combined area of Mendocino and Sonoma Counties (USACE, June 1956). Over $64 million in damage and 19 deaths were the result of the 1964 flood on the Eel River (Winsler & Kelly Consulting Engineers, May 1970; USGS, 1969). Most of the damage and destruction resulting from the 1955 and 1964 floods in the Russian and Eel River watersheds occurred in the areas downstream and outside of Mendocino County.

City of Point Arena

Flooding along the Pacific coast at Point Arena is typically associated with the simultaneous occurrence of very high tides, large waves, and storm swells during the winter. As a result, ocean-front development has not been compatible with the natural instability of the shoreline and the intense winter weather conditions.

Tsunami (sea waves generated from oceanic earthquakes, submarine landslides, and volcanic eruptions) create some of the most destructive natural water waves. As tsunami waves approach shallow coastal waters, wave refraction, shoaling, and bay resonance amplify the wave heights.

Storm centers from the southwest produce the type of storm pattern most commonly responsible for the majority of the serious coastal flooding. The strong winds and high tides that create storm surges are also accompanied by heavy rains. In some instances, high tides back up riverflows, which causes flooding at the river mouth.

In the past, developed portions of the northern California coast have been damaged as a result of severe winter storms.

The most severe storms to hit the California coast occurred in 1978 and 1983, when high water levels were accompanied by very large storm waves.

In January 1978, a series of storms emanated from a more southerly direction than normally occurs; consequently, some of the better protected beaches in the area were also damaged.

The winter of 1983 brought an extremely unusual series of high tides, storm surges, and storm waves that caused damage along the northern California coast (Ott Water Engineers, Inc., August 1984).

<u>City of Ukiah</u>
The major floods in Ukiah have resulted from extended periods of winter rainfall produced by storms from the Pacific Ocean.

The eastern portion of Ukiah is subject to flooding from the Russian River. Flooding in the Russian River valley has been extensively documented by gage records, high-water marks, damage surveys, and personal accounts. Some publications have described the floods of December 1955 and December 1964 in the Russian River basin (USACE June 1956; State of California, January 1965).

The flood of 1955 was larger than the 1964 flood in the Ukiah area. The decrease in size of the peak flow in 1964 was a result of the storage of excessive flows from the East Fork Russian River into Lake Mendocino created by Coyote Dam northeast of Ukiah in 1958 (State of California, January 1965).

Past flooding problems on Orrs, Gibson, and Doolin Creeks are not documented by streamflow gage records. However, the USACE did collect and tabulate high-water-mark elevations from the 1964 flood on Orrs, Gibson, and Doolin Creeks (USACE, n.d.(c); USACE, December 1965). The locations and elevations of some of these high-water marks are found in Table 4, "High-Water Mark Elevations".

City of Willits

The major floods in Willits have resulted from extended periods of winter rainfall produced by storms from the Pacific Ocean.

The eastern section of Willits is subject to flooding from the streams flowing into Little Lake Valley from the west (Mill (at Willits) and Broaddus Creeks) and south (Haehl/Baechtel Creek). The extent of flooding has been documented by high-water-mark elevations taken by the USACE.

The USACE collected and tabulated highwater-mark elevations from the December 1964 flood on Baechtel, Broaddus, and Mill (at Willits) Creeks (USACE, n.d.(b); USACE, December 1965). The locations and elevations of some of these marks are presented in Table 4, "High-Water Mark Elevations".

The most recent flooding occurred in January 1974; however, no gage data are available to estimate the recurrence interval.

The extent of flooding for major floods other than December 1964 (December 1955, January 1974, and others) has not been documented by published high-water marks; however, the December 1964 event was the largest flood of record on Eel River, to the east of Willits. Stream blockage by debris has been cited as a problem by city officials during past floods.

The area between U.S. Highway 101 and the Southern Pacific Railroad tracks north of Mill Creek (at Willits) to the northern corporate limits is subject to shallow flooding resulting from ponding and backwater flooding. Water from the streams flowing into Little Lake Valley floods the flat valley floor, including this portion of land within the corporate limits.

2.4 Flood Protection Measures

City of Fort Bragg

There are no flood control projects existing or planned for Noyo River. The ongoing maintenance dredging conducted by the USACE to maintain channel depth provides a flood protection benefit.

Table 4 – High-Water Mark Elevations

Drainage	Location	Elevation (feet)
Ackerman Creek	On State Street bridge over Ackerman Creek, 1 mile north of Ukiah	626.76
	On south bank of Ackerman Creek, 0.7 mile upstream of State Street	641.60
Baechtel Creek	50 feet upstream of Railroad Avenue	1,371.83
	45 feet upstream of U.S. Highway 101 (Main Street)	1,385.74
Broaddus Creek	200 feet downstream of Commercial Street	1,359.50
	75 feet upstream of Main Street (U.S. Highway 101)	1,373.62
Davis Creek	On west bank of Davis Creek, 30 feet upstream of Hearst-Willits Road, 1.4 miles east of Willits	1,360.22
	On west bank of Davis Creek, 200 feet upstream of private bridge, 1 mile south of Hearst-Willits Road	1,375.27
Doolin Creek	On left bank downstream side of Doolin Creek culvert under State Street	618.79
East Fork Russian River	On east bank of the East Fork Russian River, 125 feet downstream of Main Street, at Potter Valley	936.72
	On east bank of the East Fork Russian River, 120 feet downstream of Main Street, at Potter Valley	937.97
Feliz Creek	On U.S. Highway 101 bridge over Feliz Creek	494.79
	On north bank of Feliz Creek, 200 feet upstream of Mountain House Road bridge	985.07
Forsythe Creek	On U.S. Highway 101 bridge over Forsythe Creek, near Redwood Valley	695.29
	On Uva Drive bridge over Forsythe Creek, near Redwood Valley	713.41
Gibson Creek	On left bank upstream side of State Street bridge over Gibson Creek	627.02
	On left bank, downstream side of School Street Bridge over Gibson Creek	629.02
Hensley Creek	On State Street bridge over Hensley Creek, 2 miles north of Ukiah	628.39
	On U.S. Highway 101 bridge over Hensley Creek, 2 miles north of Ukiah	629.10

Table 4 – High-Water Mark Elevations, continued

Drainage	Location	Elevation (feet)
Mill Creek (at Willits)	Mill Creek (at Willits) – 150 feet downstream of Southern Pacific Railroad bridge	1,362.00
	Mill Creek (at Willits) – 100 feet downstream of U.S. Highway 101 (Main Street)	1,370.42
Mill Creek (near Talmage)	On River Road (East Side Road) bridge over Mill Creek, at Talmage	625.91
	On Park Lane bridge over Mill Creek in the City of the Ten Thousand Buddhas, at Talmage	649.40
	On Mill Creek Road bridge over Mill Creek, near Talmage	719.54
Orrs Creek	On right bank downstream side of State Street bridge over Orrs Creek	623.85
Robinson Creek	On south bank of Robinson Creek, 50 feet upstream of U.S. Highway 101	578.60
	On north bank of Robinson Creek., 1.1 miles upstream of U.S. Highway 101	601.57
	On State Highway 253 bridge over Robinson Creek	628.22
Russian River	On U.S. Highway 101 bridge over the Russian River, 1.5 miles south of Hopland	489.72
	On State Highway 175 (River Road) bridge over the Russian River, at Hopland	494.74
	On east bank of the Russian River, 5.15 miles north of Hopland	527.69
	On east bank of the Russian River, 7.1 miles north of Hopland	547.22
	On east bank of the Russian River at River Road Ranch, 4.9 miles south of Ukiah	563.05
	On Talmage Road bridge over the Russian river, at Ukiah	586.46
	Near end of Gobbi Street, 1,000 feet west of the Russian River	592.46
	On Vichy Springs Road (E. Perkins St.) bridge over the Russian River, at Ukiah	596.53
	On west bank of the Russian river, near bed of Ford Road in Ukiah	603.21
	At mouth of Orrs Creek	605.01
	On east bank of the Russian River, 300 feet downstream of Lake Mendocino Drive, north of Ukiah	627.64

Table 4 – High-Water Mark Elevations, continued

Drainage	Location	Elevation (feet)
Russian River (continued)	East bank of the Russian River, 1 mile south of Calpella	657.17
	On State Highway 20 bridge over the Russian River, north of Calpella	675.51
	On Southern Pacific Railroad bridge over the Russian River, 1,700 feet upstream of School Way in Redwood Valley	712.17
Town Creek	On State Highway 162 (Covelo Road) bridge over Town Creek, at Covelo	1,393.66
	On Airport Road bridge over Town Creek, at Covelo	1,408.09
York Creek	On north bank of York Creek, 54 feet upstream of U.S. Highway 101, 2.2 miles south of Calpella	641.58
	On south bank of York Creek at Round Mountain Ranch, 1 mile upstream of U.S. Highway 101	677.25

<u>Mendocino County (Unincorporated Areas)</u>
There are no flood-control structures on Russian River, or Eel River.

Coyote Dam (Lake Mendocino) was constructed in 1958 by the USACE on the East Fork Russian River below Potter Valley to decrease and store floodwaters before entering the Russian River. The reservoir has the capacity and is operated in a manner to completely cut off all flow from the East Fork Russian River during flooding, as was the case in the 1964 flood (State of California, January 1965). The storage of this reservoir removes the runoff from 105 square miles and prevents contribution to the flooding of the Russian River below the confluence with the East Fork Russian River. Coyote Dam controls 1-percent-annual-chance flooding on the East Fork Russian River.

On the Eel River within and upstream of the detailed-study area, Pacific Gas and Electric owns and operates two reservoirs (Van Arsdale Reservoir and Lake Pillsbury) for hydroelectric power generation. The reservoirs are not operated for flood-control purposes and the extent of flood attenuation varies with each flood event and depends on the level of the reservoir at the time of the flood (Pacific Gas and Electric, April 1979). Van Arsdale Reservoir (Cape Horn Dam) has a maximum storage capacity of 390 acre-feet when 4-foot flashboards are added in the summer. Approximately 300 cfs is diverted from the Eel River at Van Arsdale Reservoir and is transferred into the water-shed of the East Fork Russian River at Potter Valley for hydro-electric power generation. Lake Pillsbury (Scott Dam in adjacent Lake County) has a maximum storage capacity of 15,000 acre-feet and regulates the flow from 288 square miles of the Eel River watershed. The flood attenuation effect of these reservoirs on 1-percent-annual-chance flooding in the detailed study area is small.

In the upper reaches of Town Creek in Round Valley, the channel banks have been built up and the stream channel widened to contain flooding. The raised banks extend to 250 feet downstream of the upstream study limit. The banks were constructed by bulldozing channel deposits to form levees. They contain the 10-, 2-, 1-, and 0.2-percent-annual-chance floods with 4.7 feet of freeboard on the northern bank and 4 feet of freeboard on the southern bank. These levees are not accredited by FEMA and are not shown on the FIRM.

The Mendocino County Planning Department has established flood plain zoning ordinances which control development in areas subject to tidal and riverine flooding (Mendocino County, n.d.). These zoning ordinances are primarily based on information supplied by the USACE and that shown on the Flood Hazard Boundary Map (FHBM) (USHUD, April 1978).

City of Point Arena
No structural or nonstructural flood plain management measures are in effect for the City of Point Arena.

City of Ukiah
The only flood protection structures in the City of Ukiah are located along sections of Gibson Creek between Orchard Street and Warren Drive where the streambanks have been replaced with reinforced concrete walls to contain minor floods. These measures provide only minimal protection against the floods evaluated in this study.

Coyote Dam (Lake Mendocino), located northeast of the city on the East Fork Russian River, provides some flood protection to Ukiah and the adjacent Russian River valley. The dam and reservoir store peak floodflows from the East Fork Russian River and thereby diminish Russian River peak discharges at Ukiah, and reduce the effect on the 1- and 0.2-percent-annual-chance floods.

The City of Ukiah has not established a flood plain zoning ordinance.

City of Willits

The only flood protection structures in the City of Willits are sections of streambanks along the detailed study streams that have been built up to contain minor floods. These measures have been considered in the analysis, although they provide only minimal protection against the floods evaluated in this study.

3.0 ENGINEERING METHODS

For the flooding sources studied by detailed methods in the community, standard hydrologic and hydraulic study methods and coastal hazard analyses were used to determine the flood hazard data required for this study. Flood events of a magnitude that are expected to be equaled or exceeded once on the average during any 10-, 50-, 100-, or 500-year period (recurrence interval) have been selected as having special significance for floodplain management and for flood insurance rates. These events, commonly termed the 10-, 50-, 100-, and 500-year floods, have a 10-, 2-, 1-, and 0.2-percent-annual-chance, respectively, of being equaled or exceeded during any year. Although the recurrence interval represents the long-term, average period between floods of a specific magnitude, rare floods could occur at short intervals or even within the same year. The risk of experiencing a rare flood increases when periods greater than 1 year are considered. For example, the risk of having a flood that equals or exceeds the 1-percent-annual-chance (100-year) flood in any 50-year period is approximately 40 percent (4 in 10); for any 90-year period, the risk increases to approximately 60 percent (6 in 10). The analyses reported herein reflect flooding potentials based on conditions existing in the community at the time of completion of this study. Maps and flood elevations will be amended periodically to reflect future changes.

Flood hazards along the northern California coast may be generated by swell waves from offshore storms, by wind waves from landfalling storms, or by tsunami. The degree of hazard depends on the water-surface elevation of the astronomical tide at the time of the wave or tsunami. To evaluate the flood hazards in the City of Point Arena, detailed engineering studies separately defined the runup magnitude and frequency of astronomical tide plus swell waves arriving from both the northwest and southwest, the runup magnitude and frequency of tide plus wind waves arriving from both the northwest and southwest, and the magnitude and frequency of tide plus tsunami. These magnitude and frequency relations were statistically combined to provide a comprehensive evaluation of the coastal flood hazard in the City of Point Arena.

Details of the engineering analyses are provided in Northern California Coastal Flood Studies (Ott Water Engineers, Inc., August 1984), and a summary of the analyses is presented in Section 3.3.

3.1 Hydrologic Analyses

Hydrologic analyses were carried out to establish the peak discharge-frequency relationships for the flooding source studied in detail affecting the community.

Peak discharge-drainage area relationships for the 10-, 2-, 1-, and 0.2-percent-annual-chance floods for each stream studied by detailed methods are presented in Table 5, "Summary of Discharges".

Table 5 – Summary of Discharges

		PEAK DISCHARGES (cfs)			
FLOODING SOURCE AND LOCATION	**DRAINAGE AREA (sq. miles)**	**10%-ANNUAL-CHANCE**	**2%-ANNUAL-CHANCE**	**1%-ANNUAL-CHANCE**	**0.2%-ANNUAL-CHANCE**
ACKERMAN CREEK					
At the confluence with the Russian River	20.6	3,190	4,800	5,370	7,000
At Orrs Springs Road	19.0	3,060	4,700	5,320	6,600
ANDERSON CREEK					
At the confluence with Con Creek	35.4	5,230	8,060	9,140	11,800
Upstream of the confluence with Robinson Creek	24.0	3,670	5,730	6,520	8,460
Upstream of the confluence with Donelly Creek	21.7	3,360	5,240	5,970	7,750
At State Highway 253	14.3	2,280	3,630	4,150	5,460
BROADDUS CREEK					
785′ upstream of State Highway 20[1]	7.8	1,500	2,340	2,710	3,530
DAVIS CREEK					
530′ downstream of confluence with Fulweiter Creek[1]	14.3	2,180	3,460	4,030	5,300
DOOLIN CREEK					
At the confluence with the Russian River	7.2	1,040	1,650	1,880	2,460
Above the confluence with Gibson Creek	4.3	660	1,060	1,200	1,570

[1] Location is the upstream boundary condition in a two-dimensional model and does not include any flows from contributing streams

Table 5 – Summary of Discharges, continued

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs) 10%-ANNUAL-CHANCE	2%-ANNUAL-CHANCE	1%-ANNUAL-CHANCE	0.2%-ANNUAL-CHANCE
DOOLIN CREEK (continued)					
Above the confluence with Mendocino Creek	3.0	480	770	880	1,150
Above the confluence with Tributary near State Street	2.1	383	627	721	957
EAST FORK RUSSIAN RIVER					
0.3 mile downstream of Centerville Road	29.1	4,050	6,050	6,810	8,640
EEL RIVER					
At the confluence with Hale Creek	35.3	41,000	70,000	82,500	11,2000
FELIZ CREEK					
At the confluence with the Russian River	43.3	5,990	8,230	9,160	11,470
At Old Hopland-Yorkville Road	31.1	4,550	6,290	7,040	8,940
FORSYTHE CREEK					
At the confluence with the Russian River	49.7	6,940	10,500	11,900	15,200
Upstream of the confluence with Seward Creek	34.6	5,120	7,900	8,960	11,600
Upstream of the confluence with Bakers Creek	32.5	4,810	7,460	8,480	11,000
Upstream of the confluence with Mill Creek (at Redwood Valley)	18.7	3,070	4,790	5,450	7,060
GIBSON CREEK					
At the confluence with Doolin Creek	2.9	466	748	854	1,120
At West Standley Street	1.5	266	459	538	743

Table 5 – Summary of Discharges, continued

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs) 10%-ANNUAL-CHANCE	2%-ANNUAL-CHANCE	1%-ANNUAL-CHANCE	0.2%-ANNUAL-CHANCE
HAEHL/BAECHTEL CREEK					
Along Baechtel Creek 3000’ upstream of US Highway 101[1]	9.7	1,810	2,820	3,270	4,260
Along Haehl Creek 4000’ upstream of East Hill Road[1]	5.7	1,030	1,640	1,910	2,520
HENSLEY CREEK					
At the confluence with the Russian River	7.6	1,290	1,970	2,210	2,790
2.1 miles upstream of U.S. Highway 101	3.7	661	1,070	1,230	1,630
MILL CREEK (AT WILLITS)					
2900’ upstream of Mill Creek Drive[1]	9.5	1,740	2,710	3,150	4,110
MILL CREEK (NEAR TALMAGE)					
At the confluence with the Russian River	18.0	2,210	3,320	3,790	4,490
Above the confluence with McClure Creek	10.1	1,260	2,000	2,290	3,000
Above confluence with North Fork Mill Creek	4.4	610	990	1,140	1,520

[1] Location is the upstream boundary condition in a two-dimensional model and does not include any flows from contributing streams

Table 5 – Summary of Discharges, continued

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs) 10%-ANNUAL-CHANCE	2%-ANNUAL-CHANCE	1%-ANNUAL-CHANCE	0.2%-ANNUAL-CHANCE
NORTH FORK MILL CREEK					
At the confluence with Mill Creek	5.3	730	1,210	1,410	1,910
NOYO RIVER					
At U.S. Highway 1	114.0	17,740	31,085	38,000	57,367
ORRS CREEK					
At the confluence with the Russian River	10.2	1,570	2,460	2,790	3,610
At Low Gap Park	7.9	1,350	2,190	2,530	3,360
ROBINSON CREEK					
At the confluence with the Russian River	26.7	3,930	5,890	6,590	8,280
Upstream of the confluence with Unnamed Tributary near State Highway 253 Crossing	20.5	3,240	5,020	5,680	7,310
1.4 miles upstream of State Highway 253	16.3	2,620	4,150	4,720	6,210
2.2 miles upstream of State Highway 253	10.2	1,770	2,810	3,220	4,210

Table 5 – Summary of Discharges, continued

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs) 10%-ANNUAL-CHANCE	2%-ANNUAL-CHANCE	1%-ANNUAL-CHANCE	0.2%-ANNUAL-CHANCE
RUSSIAN RIVER					
At U.S. Highway 101 bridge south of Hopland	437	36,900	53,100	59,900	75,800
Upstream of the confluence with Feliz Creek	391	32,700	47,100	53,000	67,100
At USGS gaging station near Hopland (No. 11462500)	362	30,000	43,100	48,600	61,400
Downstream of the confluence with Robinson Creek	317	26,100	37,500	42,100	53,800
Upstream of the confluence with Robinson Creek	291	23,100	33,300	37,300	46,800
Upstream of the confluence with Doolin and Mill Creek (near Talmage)	261	19,600	28,300	31,700	39,700
Upstream of the confluence with Orrs Creek	249	18,200	26,300	29,400	36,900
Downstream of the confluence with Ackerman Creek	235	16,500	23,900	26,800	33,600
Upstream of the confluence with Ackerman Creek	215	15,800	21,500	23,700	29,100
Upstream of the confluence with Hensley Creek	207	14,800	21,100	22,200	27,200
At USGS gagin station near Ukiah (No. 11461000)	99.7	14,400	19,700	21,700	26,800
Upstream of the confluence with York Creek	87.0	12,700	17,300	19,200	23,600
Upstream of the confluence with Forysthe Creek	35.0	5,310	7,620	8,480	10,600
At upstream Limit of Detailed Study	27.1	4,480	6,400	7,120	8,900

Table 5 – Summary of Discharges, continued

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs) 10%-ANNUAL-CHANCE	2%-ANNUAL-CHANCE	1%-ANNUAL-CHANCE	0.2%-ANNUAL-CHANCE
SULPHUR CREEK					
At Vichy Springs Road	5.5	950	1,380	1,600	2,130
TENMILE CREEK					
0.2 mile downstream of Branscomb Road	20.9	3,440	5,850	6,900	9,620
TOWN CREEK					
At the confluence with Grist Creek	11.3	1,300	2,280	2,720	3,890
YORK CREEK					
At the confluence with the Russian River	12.0	1,920	2,920	3,290	4,170
2.1 miles upstream of U.S. Highway 101	8.0	1,270	2,080	2,410	3,220

City of Fort Bragg

The 1-percent-annual-chance discharge in the Noyo River was computed from 32 years of USGS stream gage record using the log-Pearson Type III flood-frequency analysis. The stream gage is located approximately 2.0 miles east of the upstream project boundary and includes 106 square miles of the approximately 114 square miles of drainage area tributary to the Noyo River at the mouth. The 1-percent-annual-chance flood discharge was computed adjusting the predicted flood at the gage using area-transfer (regional USACE coefficients from Waananen and Crippen) (USGS, June 1977). The USGS considers the record to be good, and there are no diversions or regulations above the stream gage.

Mendocino County (Unincorporated Areas)

The 10-, 2-, 1-, and 0.2-percent-annual-chance peak discharges for Town Creek, Tenmile Creek, Anderson Creek, the East Fork Russian River, Forsythe Creek, Mill Creek (at Redwood Valley), York Creek, Hensley Creek, Ackerman Creek, Mill Creek (near Talmage), North Fork, Mill Creek (at Willits), Robinson Creek, and Davis Creek were generated using regional flood-frequency equations developed by the USGS (USGS, June 1977). These regional equations relate flows of various return periods to drainage area, mean annual precipitation, and watershed altitude. The equations were derived by applying multiple regression techniques to flood discharges and selected basin characteristics of 705 gaging stations with records ranging in length from 5 to 87 years. The 10-, 2-, and 1-percent-annual-chance peak flood discharges at several locations on these 13 detailed-study streams were calculated from these regional equations. The 0.2-percent-annual-chance peak flood discharges were calculated using a log-normal extrapolation based on the 2- and 1-percent-annual-chance values.

Hydrologic analyses of the Russian River, Eel River, and Feliz Creek involved both USGS peak discharge gage records and regional floodflow equations. Peak discharge records at gaging stations were used to determine the 10-, 2-, 1-, and 0.2-percent-annual-chance floodflows using a log-Pearson Type III analysis in accordance with U.S. Water Resources Council (USWRC) guidelines (USWRC, June 1977). To determine peak floodflows at locations upstream or downstream from a gaging station, the station’s log-Pearson Type III values were transposed according to the following relationship (USHUD, April 1978):

$$Q_{site} = Q_{gage} \left(A_{site}{}^{0.9} / A_{gage}\right)$$

where Q_{site} is the discharge at the point of interest
Q_{gage} is the discharge at the gage
A_{site} is the drainage area at the point of interest
A_{gage} is the drainage area at the gage

The value of the transposition exponent (0.9) was selected based on an analysis of discharge-drainage area relationships at several locations in the Eel River watershed.

The length of record at the gage was adjusted for weighting purposes in accordance with the difference in drainage area between the gage and point of interest. The gage was given no weight if the area at the site was greater than three times the watershed area or less than one-third of the area at the gage. The regional equations were also used to determine the location site's flood-frequency values and were weighted according to the equivalent years of record for each return period. For locations between two gages, a final weighted flow value was based on three separate estimates: the upstream transposed gage, the downstream transposed gage, and the regional equations (USGS, May 1975).

This combined analysis was done for each point of interest on the Russian River, Eel River, and Feliz Creek. The USGS gages used in the analyses are shown in Table 6, “Gaging Station Data”.

Analysis of the floodflows on the Russian River takes into account the release operation policy of the USACE for Lake Mendocino. This reservoir on the East Fork Russian River delays and decreases the size of the floods from the East Fork Russian River. The release operation policy results in no addition to the peak flows of the mainstream of the Russian River from the East Fork Russian River, as these flows are held in the reservoir until after the peak on the main stem has passed the confluence (USACE, June 1956). Thus, for the Russian Rivers the drainage area of the East Fork Russian River was not included in the flood-frequency analysis.

In another study conducted by the USACE, discharge-frequency curves have been developed from the records at the Russian River USGS gages near Hopland (No. 11462500), with a drainage area of 362 square miles and near Ukiah (No. 11461000), with a drainage area of 100 square miles (USACE, n.d.(a)). These discharges are different than those listed in Table 5, "Summary of Discharges".

	Discharge (cfs)			
GAGE LOCATION	10% ANNUAL-CHANCE	2% ANNUAL-CHANCE	1% ANNUAL-CHANCE	0.2% ANNUAL-CHANCE
Near Hopland	29,200	40,000	44,400	54,500
Near Ukiah	14,700	19,600	21,400	25,500

A study conducted for the Mendocino County Department of Public Works calculated peak-flow values for the Russian River at Vichy Springs Road near Ukiah (CH2M Hill, Inc., February 1979). This study determined discharges of 22,000, 26,000, 29,100, and 32,200 cfs for the 10-, 2-, 1-, and 0.2-percent-annual-chance floods, respectively. These discharges are not listed in Table 5, "Summary of Discharges".

Analysis of floodflows for the Eel River and the East Fork Russian River included the diversion of 300 cfs from the Eel River at Van Arsdale Reservoir to the upper reaches of the East Fork Russian River. For each of the selected flood events, 300 cfs was subtracted from the Eel River flows below Van Arsdale Reservoir and added to the East Fork Russian River flows.

The Noyo River watershed is approximately 114 square miles. There are no dams or diversions on the Noyo River.

City of Ukiah

There are no useful streamflow gage records on Orrs, Gibson, and Doolin Creeks that can be used to determine flood frequency.

The 10-, 2-, 1-, and 0.2-percent-annual-chance peak discharges used in studying Orrs, Gibson, and Doolin Creeks were generated by applying regional flood-frequency equations (USGS, June 1977). These equations relate discharges with return periods of 10, 2, and 1-percent-annual-chance to drainage area, mean annual precipitation, and altitude index. The equations were derived by applying multiple regression techniques to the flow data and basin characteristics of several gaging stations in the north coast region of California. The 10-, 2-, and 1-percent-annual-chance peak discharges at several sites on the streams were calculated from the regional equations. A 0.2-percent-annual-chance discharge was calculated at each site by extrapolation from the other three frequency data points.

Peak discharge-drainage area relationships for Orrs, Gibson, and Doolin Creeks, and the Russian River are shown in Table 5, "Summary of Discharges".

City of Willits

There are no useful streamflow gage records on the detailed study streams that can be used to determine flood frequency.

The 10-, 2-, and 1-percent-annual-chance peak discharges used in studying Haehl/Baechtel, Broaddus, and Mill (at Willits) Creeks were generated by applying regional flood-frequency equations (USGS, June 1977). These equations relate discharges with return periods of 10, 2, and 1-percent-annual-chance to drainage area, mean annual precipitation, and altitude index. The equations were derived by applying multiple-regression techniques to flow data and basin characteristics of several gaging stations in the north coast region of California. The 10-, 2-, and 1-percent-annual-chance year peak discharges at several sites on the streams were calculated from the regional equations. A 0.2-percent-annual-chance discharge was calculated at each site by extrapolation from the other three frequency data points.

Table 6 – Gaging Station Data

Gage/Location/Number	Drainage Area (Square Miles)	Period of Record
Russian River		
Near Healdsburg		
(11464000)	793	1959-76
Near Cloverdale		
(11463000)	503	1959-79
Near Hopland		
(11462500)	362	1959-79
Near Ukiah		
(11461000)	99.7	1953-76
Near Redwood Valley		
(11461000)	14.1	1964-76
Eel River		
Above Dos Rios		
(11472500)	705	1951-65
Near Dos Rios	528	1965-77
At Van Arsdale Reservoir		
(11471500)	349	1910-77
Feliz Creek		
Near Hopland	31.1	1958-66

3.2 Hydraulic Analyses

Analyses of the hydraulic characteristics of flooding from the sources studied were carried out to provide estimates of the elevations of floods of the selected recurrence intervals. Users should be aware that flood elevations shown on the FIRM represent rounded whole-foot elevations and may not exactly reflect the elevations shown on the Flood Profiles or in the Floodway Data tables in the FIS report. Flood elevations shown on the FIRM are primarily intended for flood insurance rating purposes. For construction and/or floodplain management purposes, users are cautioned to use the flood elevation data presented in this FIS in conjunction with the data shown on the FIRM.

Channel and overbank roughness factors (Manning's "n") used in the hydraulic computations were estimated by engineering judgment and based on field observation at each cross-section and adjusted with known high-water marks and stream gage rating curves where possible. Table 7, "Manning's "n" Values", shows the channel and overbank "n" values for the streams studied by detailed methods.

Locations of selected cross sections used in the hydraulic analyses are shown on the Flood Profiles (Exhibit 1). For stream segments for which a floodway was computed (Section 4.2), selected cross-section locations are also shown on the FIRM (Exhibit 2).

The hydraulic analyses for this study were based on unobstructed flow. The flood elevations shown on the Flood Profiles (Exhibit 1) are thus considered valid only if hydraulic structures remain unobstructed, operate properly, and do not fail.

<u>City of Fort Bragg</u>
Cross-section data for the backwater analysis were obtained from topographic maps compiled from aerial photography, and bathymetric maps compiled from bathymetric surveys conducted as a part of channel maintenance dredging. Geometry of the Highway 1 bridge was obtained from construction drawings for the bridge.

Water-surface elevations (WSELs) for the 1-percent-annual-chance flood were computed using the USACE HEC-2 step-backwater computer program (USACE, August 1979). The starting water-surface elevation at the mouth of the Noyo River was taken as Mean Higher water, elevation 6.0 feet NAVD88. This elevation did not control the backwater calculation.

Mendocino County (Unincorporated Areas)
The overbank portions of the cross section data for the detailed-study streams were obtained from topographic mapping and digitized ground elevation locations (Towill Corporation, September 1979(a)). Those portions of the cross sections located within the limits of the stream channels were obtained by field survey and/or photogrammetric digitization. Bridge plans were utilized to obtain elevation data and structural geometry for bridges over the streams studied in detail. Bridges and culverts were surveyed where plans were unavailable or out-of-date.

Cross sections for the backwater analyses were located at close intervals above and below structures to compute the significant backwater effects of these structures; appropriate valley cross sections were also included in the backwater analyses.

WSELs of 10-, 2-, 1-, and 0.2-percent-annual-chance floods were computed for all streams in the study through the use of the USACE HEC-2 step-backwater computer program (USACE August 1979).

Roughness coefficients (Manning's "n") were chosen on the Russian River, Forsythe Creek, York Creek, Hensley Creek, Ackerman Creek, East Fork Russian River, Mill Creek (near Talmage), Robinson Creek, Feliz Creek, Town Creek, Davis Creek, Orrs Creek, Gibson Creek, Doolin Creek, Haehl/Baechtel Creek, and Mill Creek (at Willits) to calibrate the results of the computer modeling to high-water marks from the December 1964 flood (USACE, n.d.(b); USACE, n.d.(c); and USACE, December 1965). For the Russian River, the rating curves of the two USGS gaging stations in the detailed-study area were also used to determine roughness coefficients for the channel and overbanks. On the other study streams, roughness coefficients were estimated by field inspection and shown in Table 7, “Manning’s “n” Values”.

The starting WSELs for each of the streams (except North Fork Mill Creek) were determined by the slope-area method, an option in the HEC-2 program (USACE, August 1979). The starting WSELs for North Fork Mill Creek was set equal to the WSELs of Mill Creek (near Talmage) at their confluence. The two streams are of equal size at the confluence and it is likely that peak discharges will occur on both creeks at the same time. For this reason, the assumption of equal WSELs at their confluence was made.

In those areas where the backwater analyses indicated supercritical flow conditions, critical depth was assumed for the flood elevations because of the inherent instability of supercritical flow.

Gibson Creek flood elevations area controlled by the Russian River.

The hydraulics of flooding on the Gualala River were originally attributed to the occurrence of high ocean water levels that would back up riverflow at the mouth. Field surveys and hydraulic analyses established that the sand spit at the mouth was formed by wave action and its elevation exceeded the maximum stillwater ocean level plus wave setup. Tsunami would not affect the Gaulala River because a sand spit protects the study area.

The maximum WSELs of the Gualala River was determined by treating the blocking sand spit as a broad-crested weir during flood events on the stream. The sand spit at the mouth of the Gualala River is assumed to back up flooding from the Gualala River just before breaching. Actual ocean levels at the time of breach have no influence on water-surface elevations from the Gualala River. The water level so produced was consistent with local observations and was used in the delineation of flooding (Ott Water Engineers, Inc., August 1984).

The numerous streams studied by approximate methods were analyzed based on a review of the following information: the Flood Hazard Boundary Map (FHBM) (USHUD, April 1978); the results of HEC-2 computer backwater computations in adjacent detailed-study areas; the floodplain delineations previously developed in the City of Willits FIS (FEMA, September 1988(a)); and high-water mark data gathered by the USACE after the flood of December 1964 (USACE, n.d.(b); USACE, n.d.(c); and USACE, December 1965).

Approximate-study results were determined for areas subject to tidal flooding along the Pacific Ocean. The boundary of the 1-percent-annual-chance tidal storm surge was based on the delineation shown on the FHBM (USHUD, April 1978). Areas subject to wave attack are referred to as coastal high hazard zones and are designated as Zone V in this study. The boundary of the coastal high hazard zone in Mendocino County was approximately determined after considering the tidal flood plain boundary shown on the FHBM (USHUD, April 1978) and the methods of wave analysis developed by the USACE (USACE, June 1975). The area of coastal high hazard is that region where a wave of 3 feet or more in height could exist during the 1-percent-annual-chance tidal flood event. The 3-foot wave has been selected be the USACE as the minimum size wave capable of causing substantial damage upon impact to a conventional wood frame or brick veneer structure.

For the June 16, 1992 revision, cross-section data for the backwater analysis were obtained from topographic maps from aerial photography compiled by R. M. Towill, Inc., in May 1988, scale 1:2,400, contour interval 2 feet (Phillips Williams and Associates, Ltd., October 1990), and bathymetric maps compiled from bathymetric surveys as a part of channel maintenance dredging conducted by the USACE in August 1975.

Geometry of the Highway 1 bridge was obtained from construction drawings for the bridge.

WSELs for the 1-percent-annual-chance flood were computed using the USACE HEC-2 step-backwater computer program. The starting WSELs at the mouth of the river was taken as critical depth.

Floodplain boundaries were delineated using the R. M. Towill topographic maps (Phillips Williams and Associates, Ltd., October 1990).

The Mendocino County (Unincorporated Areas) study was revised on September 30, 1988. Changes were made to reflect changes in the floodplain boundary, floodway, and base (1-percent-annual-chance) flood elevations along Baechtel Creek downstream (east) of the Southern Pacific Railroad crossing. These changes were based on topographic mapping that is more detailed and more accurate than that used in the original FIS report for Mendocino County.

The new data was provided by T.M. Herman and Associates, Willits, California, and consisted of a topographic map of the area east of the railroad crossing, including cross sections 5740 and 6710. This area was field surveyed in September 1986 and April 1987. The updated topographic information preceded the effective date of the FIRM (June 1, 1983) and there was no evidence of fill activities in the floodplain. Revised HEC-2 hydraulic computer model analyses utilizing the new mapping were conducted for Baechtel Creek by Aqua Terra Consultants, Mountain View, California, in April 1987.

<u>City of Ukiah</u>
The overbank portions of the cross section data for Orrs, Gibson, and Doolin Creeks, and the Russian River were obtained from topographic mapping (Towill Corporation, September 1979(b)) and digitized ground elevation locations, except on Orrs Creek between U.S. Highway 101 and Ford Street, where the overbank portions were field surveyed.

Those portions of the cross sections located within the limits of the stream channels were obtained by field survey and/or photogrammetric digitization. Bridge plans were used to obtain elevation data and structural geometry for bridges over the streams studied in detail. Bridges and culverts were surveyed where plans were unavailable or out of date.

Cross sections for the backwater analyses were located at close intervals above and below structures in order to compute the significant backwater effects of these structures in the developed areas. In long reaches between structures, appropriate valley cross sections were also included in the backwater analyses.

WSELs of 10-, 2-, 1-, and 0.2-percent-annual-chance floods were computed for all streams in the study through the use of the USACE HEC-2 step-backwater computer program (USACE, August 1979). Roughness coefficients (Manning's “n") for the streams were chosen to calibrate the results of the computer model to high-water marks from the December 1964 flood (USACE, n.d.(c); USACE, December 1965). Coefficients are shown in Table 7, “Manning’s “n” Values”. For the Russian River, the rating curves of two USGS gaging stations within Mendocino County were also used to determine roughness coefficients for the channel and overbanks.

The starting water-surface elevations for each of the streams were determined by the slope-area method, an option in the HEC-2 program (USACE, August 1979).

In those areas where the backwater analyses indicated supercritical flow conditions, critical depth was assumed for the flood elevations because of the inherent instability of supercritical flow.

<u>City of Willits</u>
The overbank portions of the cross section data for Haehl/Baechtel, Broaddus, and Mill (at Willits) Creeks were obtained from topographic mapping and digitized ground elevation locations (Towill Corporation, September 1979(c)). Those portions of the cross sections located within the limits of the stream channels were obtained by field survey and/or photogrammetric digitization. Bridge plans were used to obtain elevation data and structural geometry for bridges over the streams studied in detail. Bridges and culverts were surveyed where plans were unavailable or out-of-date.

Cross sections for the backwater analyses were located at close intervals above and below structures in order to compute the significant backwater effects of these structures in the developed areas. In long reaches between structures, appropriate valley cross sections were also included in the backwater analyses.

WSELs of 10-, 2-, 1-, and 0.2-percent-annual-chance floods were computed for all streams in the study through the use of the USACE HEC-2 step-backwater computer program (USACE, August 1979). Roughness coefficients (Manning's "n") for the streams were chosen to calibrate the results of the computer model to high-water marks from the December 1964 flood (USACE, n.d.(b); USACE December 1965).

The starting WSELs for each of the streams were determined by the slope-area method, an option in the HEC-2 program (USACE, August 1979).

In those areas where the backwater analyses indicated supercritical flow conditions, critical depth was assumed for the flood elevations because of the inherent instability of supercritical flow.

The shallow flooding area was determined to be inundated by flooding of less than 1.0 foot in depth, based on engineering judgment.

STREAM	**CHANNEL**	**OVERBANK**
Ackerman Creek	0.013 – 0.070	0.040 – 0.180
Anderson Creek	0.013 – 0.070	0.040 – 0.180
Broaddus Creek	0.045 – 0.070	0.090 – 0.120
Davis Creek	0.013 – 0.070	0.040 – 0.180
Doolin Creek	0.013 – 0.070	0.040 – 0.180
East Fork Russian River	0.013 – 0.070	0.040 – 0.180
Eel River	0.013 – 0.070	0.040 – 0.180
Feliz Creek	0.013 – 0.070	0.040 – 0.180
Forsythe Creek	0.013 – 0.070	0.040 – 0.180
Gibson Creek	0.013 – 0.070	0.040 – 0.180
Haehl/Baechtel Creek	0.013 – 0.070	0.040 – 0.180
Hensley Creek	0.013 – 0.070	0.040 – 0.180
Mill Creek (at Willits)	0.013 – 0.070	0.040 – 0.180
Mill Creek (at Redwood Valley)	0.013 – 0.070	0.040 – 0.180
Mill Creek (near Talmage)	0.013 – 0.070	0.040 – 0.180
North Fork Mill Creek	0.013 – 0.070	0.040 – 0.180
Noyo River	0.030 – 0.035	0.035 – 0.120
Orrs Creek	0.013 – 0.070	0.040 – 0.180
Robinson Creek	0.013 – 0.070	0.040 – 0.180
Russian River	*	*
Tenmile Creek	0.013 – 0.070	0.040 – 0.180
Town Creek	0.013 – 0.070	0.040 – 0.180
York Creek	0.013 – 0.070	0.040 – 0.180

* Data Not Available

3.3 Coastal Hazard Analyses

Swell-wave and wind-wave frequency and magnitude components were determined by a two-step process. The first step defined a stillwater elevation that included effects of astronomical tide, storm surge, and wave setup. The second step determined wave runup above the stillwater elevation onto the beach.

Storm surge is the superelevation of the water level above the astronomical tide elevation caused by the low barometric pressure and wind stresses of a storm. Storm surge was evaluated only for definition of the wind-wave component of landfalling storms. Setup is an additional superelevation of the water surface produced by wave action, and the magnitude of wave setup varies with wave characteristics, bathymetry, and beach profile. Because wave setup varies with the characteristics of the waves, different stillwater elevations and magnitude relations were defined for wind waves from the northwest, wind waves from the southwest, swell waves from the northwest, and swell waves from the southwest. Wave runup is the maximum elevation of a wave breaking onto a beach and varies with wave characteristics, bathymetry, and beach profile.

The storm surge at Point Arena was defined by a two-dimensional, finite-element computer model (Pagenkopf, August 1976). Applicability of the model had been tested by using long-term climatic records for San Francisco (NCDC, 1944-1983) to synthesize a long-term record of storm surge hydrographs for San Francisco Bay. The close comparison of synthesized data with available tidal records confirmed the usability of the model for California storm conditions. For Point Arena, the model synthesized a record of storm surges from both the northwest and southwest quadrants based on windspeed, wind direction, and barometric pressure data, from 1955 to 1983, determined from North American Surface Weather Maps (NCDC, 1955-1983).

The effects of storm surge were combined with astronomical tide and wave setup to define the stillwater elevation needed to evaluate the wind-wave runup. Characteristics of astronomical tide at Santa Cruz could be reliably defined from previous studies (NOAA, 1945-1983) and were convoluted with storm surge (USACE, 1977). The magnitude of wind-wave setup was calculated by an iterative process coupled with the wave runup calculations.

Runup of wind waves was evaluated by first determining the deepwater wave conditions from both the southwest and northwest quadrants using the 1955-to-1983 climatic data and methods described in USACE's Shore Protection Manual (USACE, 1977). A wave tracking model (Dobson, March 1967) then transformed the deepwater waves as they traveled toward the shoreline, on the basis of bathymetry and beach profiles. Beach transects along the coast provided a generalized representation of the beach profiles, which control the magnitude of wave runup. In coastal-study areas, beach transects were oriented perpendicular to the shoreline and were strategically located along the shore to represent reaches with similar characteristics (See Figure 1). Data were primarily obtained from offshore bathymetry maps supplemented with 1978 USACE survey data (USACE, 1978). Table 8, "Transect Locations," provides a listing of the transect locations, as well as wave runup elevations, and Figure 2 presents a sample transect. The wave runup along sloping sandy beaches was computed by Hunt's method (Hunt, 1959); at obstructions, it was computed by Stoa's method (USACE, July 1978).

The elevation-probability distribution for swell waves followed a similar development. Stillwater was defined only from wave setup convoluted with astronomical tide. The frequency of offshore wave height and wave period from the northwest and southwest quadrants were determined from available data (Meteorology International, Inc., n.d.) and routed shoreward with the wave tracking model. The runup elevation at each beach transect was calculated using Hunt's and Stoa's methods.

Table 8 – Transect Locations

		Wave Run-up (feet- NAVD88)	
Transect Number	**Location**	**1% Annual-Chance**	**0.2% Annual-Chance**
1	From the beach, east 170 feet to the launch ramp at the southwest corner of the boat house.	22.4	25.4
2	From the water's edge, 330 feet southeast to the upper end of the bridge.	22.4	25.4

Tsunami plus astronomical tide elevations having 1- and 0.2-percent-annual-chance recurrence intervals have been published (USACE, May 1974; USACE, December 1978; and USACE, February 1979), and for the analysis at Point Arena, the complete magnitude-frequency relationship was defined from supporting data for those earlier studies.

The joint probability of wind waves from the northwest and southwest quadrants, swell waves from the northwest and southwest quadrants, and tsunami was defined on the assumption that the events are independent. Results of the analysis are shown in Table 9, "Summary of Stillwater Elevations."

Table 9 – Summary of Stillwater Elevations

	Stillwater Elevations (feet-NAVD88)			
Flooding Source and Location	**10% Annual-Chance**	**2% Annual-Chance**	**1% Annual-Chance**	**0.2% Annual-Chance**
Pacific Ocean				
At Point Arena	8.2	8.6	8.7	9.0

Note that the stillwater levels used for the wave runup analysis are not the same as the 10-, 2-, 1-, and 0.2-percent-annual-chance stillwater levels determined for flood mapping. Stillwater levels used for wave runup analysis are associated with a particular wave type and direction. Stillwater levels used for flood mapping in wave-protected areas are based upon tidal record adjusted for local differences in astronomical tide and storm surge. (Ott Water Engineers, August 1984).

3.4 Vertical Datum

All FIS reports and FIRMs are referenced to a specific vertical datum. The vertical datum provides a starting point against which flood, ground, and structure elevations can be referenced and compared. Until recently, the standard vertical datum used for newly created or revised FIS reports and FIRMs was the National Geodetic Vertical Datum of 1929 (NGVD 29). With the completion of the North American Vertical Datum of 1988 (NAVD 88), many FIS reports and FIRMs are now prepared using NAVD 88 as the referenced vertical datum.

Prior versions of the FIS report and FIRM were referenced to NGVD 29. When datum conversion is effected for an FIS report and FIRM, the flood profiles, and Base Flood Elevations (BFEs), reflect the new datum values. To compare structure and ground elevations to 1-percent-annual-chance (100-year) flood elevations shown in the FIS and on the FIRM, the subject structure and ground elevations must be referenced to the new datum values.

The conversion from NGVD 29 to NAVD 88 ranged between +2.84 and +3.05 for Mendocino County. Accordingly, due to the statistically significant range in conversion factors, an average conversion factor could not be established for the entire county. The elevations shown in the FIS report and on the FIRM were, therefore, converted to NAVD 88 using a stream-by-stream approach. In this method, an average conversion was established for each flooding source and applied accordingly. The conversion factor for each flooding source in the county may be found in Table 10, “Vertical Datum Conversions”.

The BFEs shown on the FIRM represent whole-foot rounded values. For example, a BFE of 102.4 will appear as 102 on the FIRM and 102.6 will appear as 103. Therefore, users that wish to convert the elevations in this FIS to NGVD 29 should apply the stated conversion factor(s) to elevations shown on the Flood Profiles and supporting data tables in the FIS report, which are shown at a minimum to the nearest 0.1 foot.

Table 10 – Vertical Datum Conversion

Stream Name	Conversion Factor (ft)
Ackerman Creek	+2.88
Anderson Creek	+2.91
Broaddus Creek	+3.01
Davis Creek	+3.01
Doolin Creek	+2.87
East Fork Russian River	+2.86
Eel River	+2.96
Feliz Creek	+2.85
Forsythe Creek	+2.90
Gibson Creek	+2.88
Haehl/Baechtel Creek	+3.01
Hensley Creek	+2.88
Mill Creek (at Redwood Valley)	+2.98
Mill Creek (at Talmage)	+2.87
Mill Creek (at Willits)	+3.01
North Fork Mill Creek	+2.88
Noyo River	+2.95
Orrs Creek	+2.88
Robinson Creek	+2.91
Russian River	+2.85
Sulphur Creek	+2.87
Tenmile Creek	+3.05
Town Creek	+2.99
York Creek	+2.88
Static Zone at Arena Cove	+2.92
Static Zone at Gualala River	+2.84

For additional information regarding conversion between the NGVD and NAVD, visit the National Geodetic Survey website at http://www.ngs.noaa.gov, or contact the National Geodetic Survey at the following address:

NGS Information Services
NOAA, N/NGS12
National Geodetic Survey, SSMC-3, #9202
1315 East-West Highway
Silver Spring, Maryland 20910-3282
(301) 713-3242

Temporary vertical monuments are often established during the preparation of a flood hazard analysis for the purpose of establishing local vertical control. Although these monuments are not shown on the FIRM, they may be found in the Technical Support Data Notebook associated with the FIS report and FIRM for this community. Interested individuals may contact FEMA to access these data.

4.0 FLOODPLAIN MANAGEMENT APPLICATIONS

The NFIP encourages State and local governments to adopt sound floodplain management programs. Therefore, each FIS provides 1-percent-annual-chance (100-year) flood elevations and delineations of the 1- and 0.2-percent-annual-chance (500-year) floodplain boundaries and 1-percent-annual-chance floodway to assist communities in developing floodplain management measures. This information is presented on the FIRM and in many components of the FIS report, including Flood Profiles and Floodway Data Table. Users should reference the data presented in the FIS report as well as additional information that may be available at the local map repository before making flood elevation and/or floodplain boundary determinations.

4.1 Floodplain Boundaries

To provide a national standard without regional discrimination, the 1-percent-annual-chance flood has been adopted by FEMA as the base flood for floodplain management purposes. The 0.2-percent-annual-chance flood is employed to indicate additional areas of flood risk in the community. For each stream studied by detailed methods, the 1- and 0.2-percent-annual-chance floodplain boundaries have been delineated using the flood elevations determined at each cross section.

The 1- and 0.2-percent-annual-chance floodplain boundaries are shown on the FIRM (Exhibit 2). On this map, the 1-percent-annual-chance floodplain boundary corresponds to the boundary of the areas of special flood hazards (Zones A, AE, V and VE), and the 0.2-percent-annual-chance floodplain boundary corresponds to the boundary of areas of moderate flood hazards. In cases where the 1- and 0.2-percent-annual-chance floodplain boundaries are close together, only the 1-percent-annual-chance floodplain boundary has been shown. Small areas within the floodplain boundaries may lie above the flood elevations but cannot be shown due to limitations of the map scale and/or lack of detailed topographic data.

For streams studied by approximate methods, only the 1-percent-annual-chance floodplain boundary is shown on the FIRM.

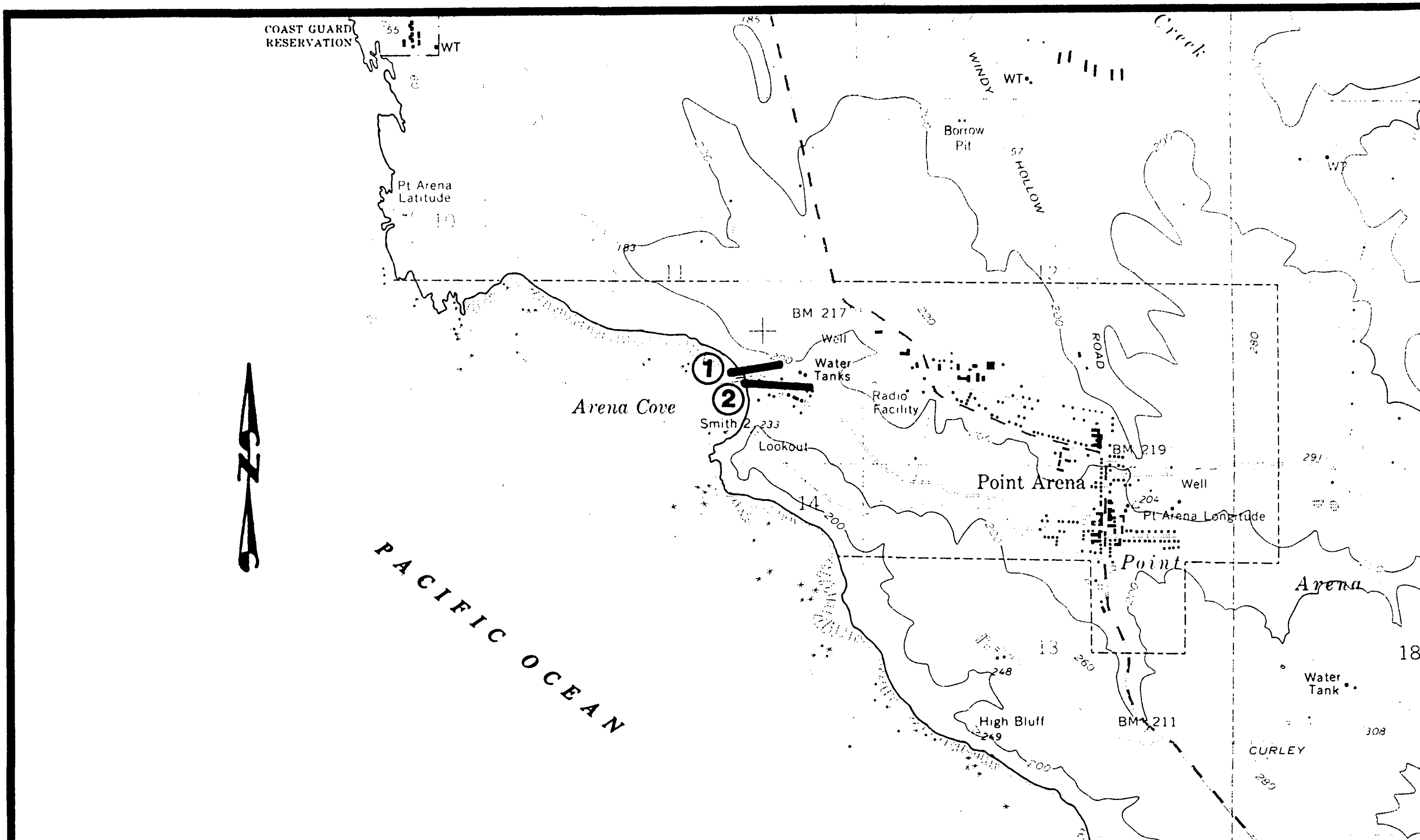

FIGURE 1

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF POINT ARENA, CA
(MENDOCINO CO.)

APPROXIMATE SCALE IN FEET
1000 0 1000 3000 5000 7000

TRANSECT LOCATIONS

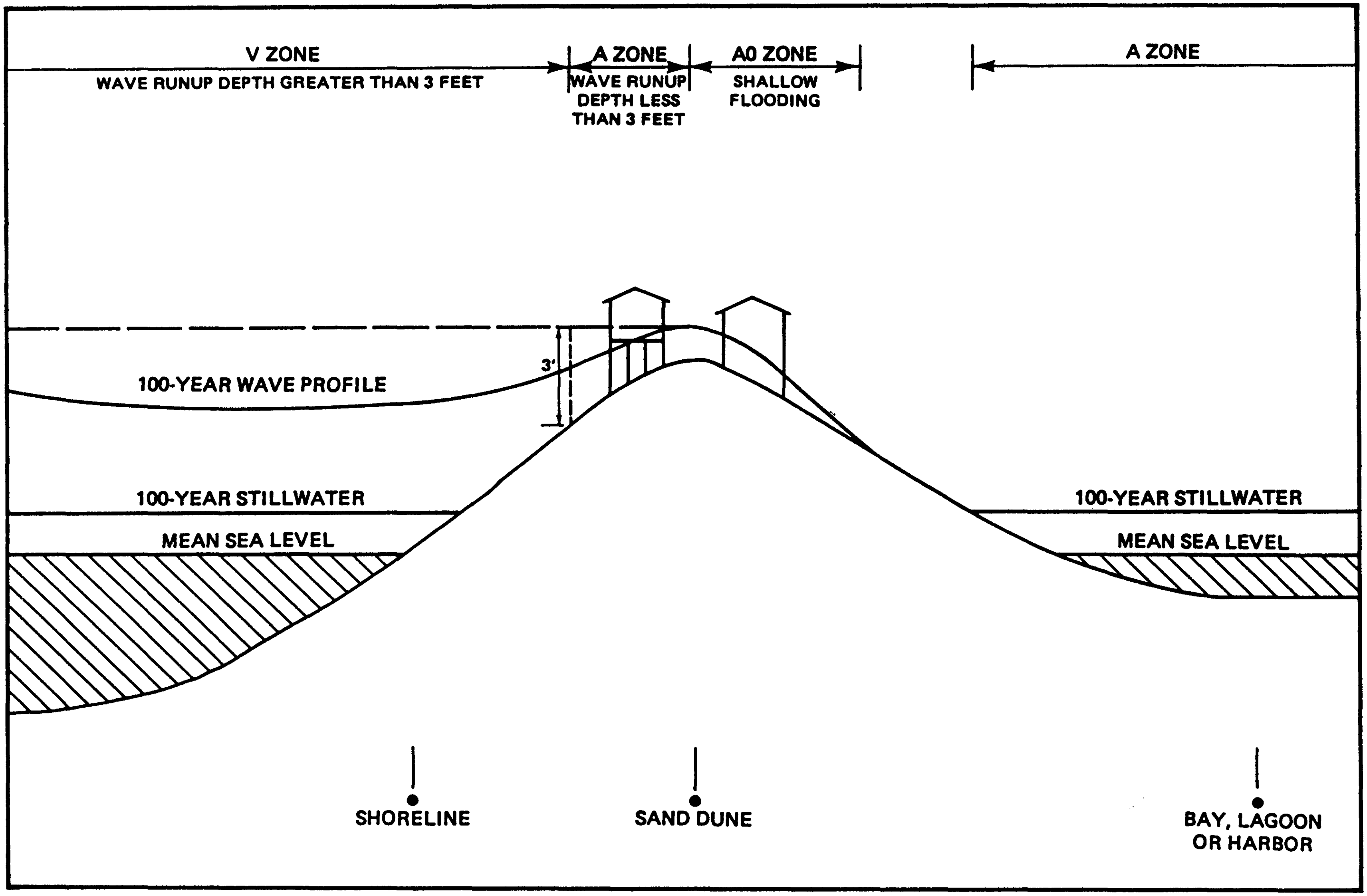

FIGURE 2
TYPICAL TRANSECT SCHEMATIC

City of Fort Bragg

Between cross sections, the boundaries were interpolated using topographic maps at a scale of 1:2,400, with a contour interval of 2 feet (Philip Williams and Associates, October 1990).

Approximate 1-percent-annual-chance floodplain boundaries in some portions of the study area were taken directly from the previously effective FIRM for the City of Fort Bragg, and the effective FIRM for Mendocino County (FEMA, December 1982 and FEMA, September 1988(b)).

Mendocino County (Unincorporated Areas)

For each stream studied in detail except the Gualala River, the 1- and 0.2-percent-annual-chance floodplain boundaries have been delineated using the flood elevations determined at each cross section. Between cross sections, the boundaries were interpolated using topographic maps at a scale of 1:4,800, with a contour interval of 5 feet (Towill Corporation, September 1979(a)). For the Gualala River, detailed floodplain boundaries were delineated using a topographic map at a scale of 1:4,800, with a contour interval of 4 feet, developed from aerial photographs (Ott Water Engineers, Inc., 1983(a)).

Approximate 1-percent-annual-chance floodplain boundaries in some portions of the study area were taken directly from the FHBM (USHUD, April 1978).

City of Point Arena

The 1- and 0.2-percent-annual-chance floodplain boundaries have been delineated using a topographic map at a scale of 1:4,800, with a contour interval of 4 feet, developed from aerial photographs (Ott Water Engineers, Inc., 1983(b)).

Approximate 1-percent-annual-chance floodplain boundaries in some portions of the study area were taken directly from the effective FIRM dated August 3, 1984 (FEMA, August 1984).

City of Ukiah

Between cross sections, the boundaries were interpolated using topographic maps at a scale of 1:4,800, with a contour interval of 5 feet (Towill Corporation, September 1979(b)).

City of Willits

Between cross sections, the boundaries were interpolated using topographic maps at a scale of 1:4800, with a contour interval of 5 feet (Towill Corporation, September 1979(c)).

The study contractor has determined that some areas shown on the FHBM (USHUD, July 1976) are areas of minimal flooding; therefore, they were not delineated on the maps. These areas include Baechtel Creek Tributary A; Baechtel Creek, upstream of U.S. Highway 101; and Broaddus Creek, upstream of Flower Street.

The flood boundaries for the shallow flooding area were developed using the determined depth in conjunction with the FHBM (USHUD, July 1976), and were delineated on the previously mentioned topographic maps (Towill Corporation, September 1979(c)).

For the countywide revision, MAP-IX added 72 miles of approximate study along the Eel River, North Fork Eel River, Middle Fork Eel River, South Fork Eel River, Grist Creek, Hulls Valley Creek, and Outlet Creek. The approximate 1-percent-annual-chance floodplain boundaries were delineated using 10 foot contours that had been created from 10 meter digital elevation models acquired from the USGS.

4.2 Floodways

Encroachment on floodplains, such as structures and fill, reduces flood-carrying capacity, increases flood heights and velocities, and increases flood hazards in areas beyond the encroachment itself. One aspect of floodplain management involves balancing the economic gain from floodplain development against the resulting increase in flood hazard. For purposes of the NFIP, a floodway is used as a tool to assist local communities in this aspect of floodplain management. Under this concept, the area of the 1-percent-annual-chance floodplain is divided into a floodway and a floodway fringe. The floodway is the channel of a stream, plus any adjacent floodplain areas, that must be kept free of encroachment so that the 1-percent-annual-chance flood can be carried without substantial increases in flood heights. Minimum Federal standards limit such increases to 1 foot, provided that hazardous velocities are not produced. The floodways in this study are presented to local agencies as minimum standards that can be adopted directly or that can be used as a basis for additional floodway studies.

The floodways presented in this FIS report and on the FIRM were computed for certain stream segments on the basis of equal-conveyance reduction from each side of the floodplain. Floodway widths were computed at cross sections. Between cross sections, the floodway boundaries were interpolated. The results of the floodway computations have been tabulated for selected cross sections (Table 11, “Floodway Data”). The computed floodways are shown on the FIRM. In cases where the floodway and 1-percent-annual-chance floodplain boundaries are either close together or collinear, only the floodway boundary has been shown.

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
ACKERMAN CREEK								
A	1,750[1]	75	938	5.7	616.5	616.1[3]	616.6	0.5
B	3,400[1]	80	424	12.7	624.1	624.1	624.1	0.0
C	4,155[1]	120	823	6.5	627.8	627.8	628.7	0.9
D	7,510[1]	160	1,043	5.1	642.4	642.4	643.0	0.6
E	9,045[1]	60	575	9.3	650.7	650.7	650.7	0.0
F	11,470[1]	40	378	14.1	673.7	673.7	673.7	0.0
ANDERSON CREEK								
A	0[2]	250	1,339	6.8	290.7	290.7	291.7	1.0
B	3,280[2]	240	843	10.8	309.2	309.2	309.2	0.0
C	6,215[2]	420	1,025	8.9	327.5	327.5	327.5	0.0
D	8,650[2]	115	754	8.6	347.6	347.6	347.8	0.2
E	10,475[2]	200	1,070	5.6	362.6	362.6	363.5	0.9
F	12,330[2]	100	537	11.1	378.7	378.7	378.7	0.0
G	14,010[2]	75	687	8.7	399.4	399.4	399.8	0.4
H	16,500[2]	130	623	9.6	422.5	422.5	423.1	0.6
I	19,030[2]	40	287	14.5	456.2	456.2	456.2	0.0

[1] Feet above confluence with Russian River

[2] Feet above 180 feet upstream of the confluence with Con Creek

[3] Elevation computed without consideration of backwater effects from Russian River

TABLE 11

FEDERAL EMERGENCY MANAGEMENT AGENCY

MENDOCINO COUNTY, CA AND INCORPORATED AREAS

FLOODWAY DATA

ACKERMAN CREEK - ANDERSON CREEK

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
DOOLIN CREEK								
A	3,330[1]	100	421	2.1	597.5	597.5	597.5	0.0
B	4,497[1]	28	129	6.8	604.9	604.9	605.8	0.9
C	4,731[1]	25	128	6.9	607.3	607.3	607.8	0.5
D	5,015[1]	18	95	9.3	610.2	610.2	610.7	0.5
E	8,195[1]	40	144	5.0	650.3	650.3	651.1	0.8
F	8,335[1]	20	83	8.7	652.1	652.1	652.3	0.2
G	8,468[1]	30	70	10.3	654.4	654.4	654.4	0.0
H	8,930[1]	16	81	8.9	660.8	660.8	660.9	0.1

[1] Feet above confluence with Russian River

TABLE 11

FEDERAL EMERGENCY MANAGEMENT AGENCY

**MENDOCINO COUNTY, CA
AND INCORPORATED AREAS**

FLOODWAY DATA

DOOLIN CREEK

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
EAST FORK RUSSIAN RIVER								
A	10[1]	70	1,070	6.4	932.2	932.2	933.2	1.0
B	1,750[1]	70	967	7.0	936.0	936.0	936.6	0.6
C	3,115[1]	115	1,587	4.3	940.5	940.5	941.1	0.6
D	4,670[1]	70	921	7.4	943.0	943.0	944.0	1.0
EEL RIVER								
A	0[2]	360	8,852	9.3	1,467.3	1,467.3	1,468.3	1.0
B	1,180[2]	290	7,262	11.4	1,468.8	1,468.8	1,469.7	0.9
C	2,310[2]	200	6,532	12.6	1,470.2	1,470.2	1,470.9	0.7
D	3,640[2]	200	5,711	14.4	1,471.6	1,471.6	1,472.0	0.4
E	5,190[2]	260	7,641	10.8	1,475.9	1,475.9	1,476.9	1.0
F	6,460[2]	260	7,153	11.5	1,477.0	1,477.0	1,477.7	0.7
G	7,790[2]	260	5,891	14.0	1,477.0	1,477.0	1,477.7	0.7
H	9,680[2]	200	4,692	17.6	1,481.7	1,481.7	1,481.8	0.1
I	12,660[2]	450	9,415	8.8	1,520.9	1,520.9	1,520.9	0.0
J	15,540[2]	410	9,171	9.0	1,521.7	1,521.7	1,522.5	0.8
FELIZ CREEK								
A	3,945[3]	1,000	1,922	4.8	498.7	491.7[4]	492.3	0.6
B	6,580[3]	1,100	5,799	1.6	502.8	502.8	503.7	0.9
C	9,690[3]	1,000	6,590	1.4	514.6	514.6	515.2	0.6
D	12,175[3]	80	852	8.3	524.8	524.8	525.1	0.3

[1] Feet above 0.3 mile downstream of Centerville Road
[2] Feet above confluence with Hale Creek
[3] Feet above confluence with Russian River
[4] Elevation computed without consideration of backwater effects from Russian River

TABLE 11

FEDERAL EMERGENCY MANAGEMENT AGENCY

MENDOCINO COUNTY, CA AND INCORPORATED AREAS

FLOODWAY DATA

EAST FORK RUSSIAN RIVER - EEL RIVER - FELIZ CREEK

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
FORSYTHE CREEK								
A	1,470	150	1,626	7.3	686.2	686.2	686.6	0.4
B	3,610	150	2,558	4.7	697.7	697.7	698.4	0.7
C	6,420	240	1,944	6.1	704.5	704.5	705.3	0.8
D	8,350	130	1,079	11.0	711.8	711.8	711.8	0.0
E	11,290	400	2,477	3.6	720.7	720.7	721.4	0.7
F	13,920	180	936	9.6	728.5	728.5	728.5	0.0
G	16,600	180	1,172	7.2	746.5	746.5	747.4	0.9
H	19,260	150	1,163	7.3	761.4	761.4	761.4	0.0
I	21,380	110	769	11.0	772.4	772.4	773.3	0.9
J	23,530	190	1,230	6.9	786.3	786.3	786.8	0.5
K	24,220	90	806	10.5	790.6	790.6	791.3	0.7

[1] Feet above confluence with Russian River

TABLE 11

FEDERAL EMERGENCY MANAGEMENT AGENCY

MENDOCINO COUNTY, CA
AND INCORPORATED AREAS

FLOODWAY DATA

FORSYTHE CREEK

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
GIBSON CREEK								
A	3,266	175	359	2.4	594.1	593.8[2]	594.7	0.9
B	4,320	50	209	4.1	598.4	598.4	599.4	1.0
C	5,565	20	125	6.8	603.6	603.6	604.2	0.6
D	5,823	25	128	6.7	605.1	605.1	605.5	0.4
E	7,280	29	170	5.0	612.2	612.2	613.1	0.9
F	7,755	50	130	6.5	619.6	619.6	619.6	0.0
G	8,748	80	156	5.5	626.3	626.3	626.4	0.1
H	9,190	90	218	3.9	628.6	628.6	629.1	0.5
I	9,480	20	89	9.6	632.4	632.4	632.4	0.0
J	9,745	30	142	6.0	634.5	634.5	635.2	0.7
K	10,043	100	205	4.2	639.4	639.4	639.4	0.0
L	10,350	60	211	4.0	640.5	640.5	641.2	0.7
M	11,755	20	100	8.5	658.4	658.4	659.1	0.7
N	13,530	30	97	8.8	697.5	697.5	697.5	0.0
O	14,475	20	68	7.9	720.2	720.2	720.2	0.0
P	15,360	15	57	9.4	812.7	812.7	812.7	0.0

[1] Feet above confluence with Doolin Creek

[2] Elevation computed without consideration of backwater effects from Russian River

TABLE 11

FEDERAL EMERGENCY MANAGEMENT AGENCY

MENDOCINO COUNTY, CA AND INCORPORATED AREAS

FLOODWAY DATA

GIBSON CREEK

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
HENSLEY CREEK								
A	1,140[1]	30	279	7.9	620.6	616.8[2]	617.3	0.5
B	1,240[1]	30	180	12.3	620.6	620.4[2]	620.4	0.0
C	1,990[1]	90	471	4.7	624.6	624.6	625.0	0.4
D	2,700[1]	80	422	5.2	626.5	626.5	627.4	0.9
E	3,085[1]	85	260	8.5	629.7	629.7	629.7	0.0
F	5,485[1]	50	242	9.1	642.8	642.8	642.9	0.1
G	8,220[1]	40	205	6.0	658.1	658.1	658.7	0.6
H	10,600[1]	80	300	4.1	675.8	675.8	676.6	0.8
I	12,640[1]	70	156	7.9	697.8	697.8	698.0	0.2
J	14,610[1]	45	165	7.4	716.3	716.3	716.4	0.1
K	17,270[1]	45	149	8.2	740.7	740.7	741.4	0.7

[1] Feet above confluence with Russian River

[2] Elevation computed without consideration of backwater effects from Russian River

TABLE 11

FEDERAL EMERGENCY MANAGEMENT AGENCY

MENDOCINO COUNTY, CA
AND INCORPORATED AREAS

FLOODWAY DATA

HENSLEY CREEK

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
MILL CREEK (AT REDWOOD VALLEY)								
A	420[1]	30	248	5.8	797.2	797.2	797.2	0.0
B	1,330[1]	40	276	12.8	805.8	805.8	805.8	0.0
C	2,000[1]	40	249	14.2	883.5	883.5	883.7	0.2
D	2,650[1]	40	263	13.5	909.8	909.8	909.9	0.1
E	2,930[1]	55	308	11.5	916.2	916.2	916.7	0.5
F	3,790[1]	50	337	10.5	934.8	934.8	935.6	0.8
G	4,900[1]	55	441	8.0	947.0	947.0	947.8	0.8
H	6,000[1]	55	420	8.4	954.5	954.5	955.4	0.9
I	8,100[1]	70	508	7.0	968.6	968.6	969.3	0.7
J	11,190[1]	85	767	4.6	990.2	990.2	990.9	0.7
K	12,620[1]	65	385	7.8	1,003.2	1,003.2	1,003.2	0.0
L	14,910[1]	50	387	7.7	1,024.7	1,024.7	1,025.1	0.4
MILL CREEK (NEAR TALMAGE)								
A	1,750[3]	650	2,125	1.8	591.3	591.3	592.1	0.8
B	2,270[3]	390	870	4.4	594.7	594.7	595.3	0.6
C	2,370[3]	390	1,061	3.6	595.5	595.5	596.4	0.9
D	2,670[3]	400	1,426	1.6	599.1	599.1	599.1	0.0
E	3,830[3]	400	552	4.1	602.7	602.7	603.6	0.9
F	4,570[3]	500	772	3.0	610.3	610.3	611.0	0.7
G	6,370[3]	290	596	3.8	625.8	625.8	626.5	0.7
H	7,845[3]	310	784	2.9	644.3	644.3	644.9	0.6
I	9,430[3]	150	707	3.2	666.6	666.6	667.5	0.9
J[2]	11,100[3]	145	266	4.3	700.0	700.0	700.3	0.3
K	11,920[3]	60	297	3.8	716.9	716.9	717.8	0.9

[1] Feet above confluence with Forsythe Creek
[2] Cross section is shared with North Fork Mill Creek
[3] Feet above confluence with Russian River

TABLE 11

FEDERAL EMERGENCY MANAGEMENT AGENCY

MENDOCINO COUNTY, CA
AND INCORPORATED AREAS

FLOODWAY DATA

MILL CREEK (AT REDWOOD VALLEY)
MILL CREEK (NEAR TALMAGE)

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
NORTH FORK MILL CREEK								
A[1]	1,470[2]	80	261	5.4	699.5	699.5	699.8	0.3
B	2,550[2]	60	277	5.1	715.6	715.6	716.4	0.8
C	3,440[2]	60	175	8.1	737.1	737.1	737.5	0.4

[1] Cross section shared with Mill Creek (near Talmage)

[2] Feet above confluence with Mill Creek (near Talmage)

TABLE 11

FEDERAL EMERGENCY MANAGEMENT AGENCY

MENDOCINO COUNTY, CA
AND INCORPORATED AREAS

FLOODWAY DATA

NORTH FORK MILL CREEK

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
ORRS CREEK								
A	2,550	45	341	8.2	603.3	603.7[2]	603.7	0.0
B	2,852	60	355	7.9	605.2	605.2	605.6	0.4
C	3,071	49	284	9.8	606.0	606.0	606.2	0.2
D	3,308	76	437	6.4	607.2	607.2	607.9	0.7
E	3,508	50	336	8.3	607.3	607.3	608.3	1.0
F	3,706	44	313	8.9	608.4	608.4	609.0	0.6
G	3,871	49	415	6.7	609.8	609.8	610.2	0.4
H	4,066	60	490	5.7	610.5	610.5	610.8	0.3
I	4,285	49	358	7.8	610.7	610.7	610.9	0.2
J	4,355	43	307	9.1	611.8	611.8	611.9	0.1
K	4,577	45	343	8.1	613.0	613.0	613.0	0.0
L	4,869	43	306	9.1	613.9	613.9	613.9	0.0
M	5,012	45	321	8.7	614.3	614.3	615.0	0.7
N	5,089	43	276	10.1	614.8	614.8	614.8	0.0
O	5,404	35	290	9.6	618.1	618.1	618.1	0.0
P	6,212	35	337	8.3	623.2	623.2	623.5	0.3
Q	7,306	95	668	4.2	627.8	627.8	628.7	0.9
R	8,013	35	284	9.8	630.1	630.1	630.7	0.6
S	8,640	50	354	7.9	634.9	634.9	635.8	0.9
T	10,565	50	425	6.6	645.7	645.7	645.9	0.2
U	13,330	50	407	6.9	661.5	661.5	661.9	0.4
V	15,020	30	191	13.2	678.9	678.9	679.2	0.3

[1] Feet above confluence with Russian River

[2] Elevation computed without consideration of backwater effects from Russian River

TABLE 11

FEDERAL EMERGENCY MANAGEMENT AGENCY

MENDOCINO COUNTY, CA
AND INCORPORATED AREAS

FLOODWAY DATA

ORRS CREEK

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
ROBINSON CREEK								
A	2,525	450	2,478	2.7	577.2	577.2	578.2	1.0
B	4,760	240	1,551	4.3	583.6	583.6	584.5	0.9
C	6,635	160	1,108	5.9	588.7	588.7	589.6	0.9
D	8,800	140	1,264	5.2	603.2	603.2	604.1	0.9
E	11,890	110	1,010	6.5	617.5	617.5	618.4	0.9
F	15,630	70	690	8.2	642.7	642.7	642.9	0.2
G	18,160	65	582	9.8	665.7	665.7	666.1	0.4
H	23,780	85	429	11.1	781.1	781.1	781.2	0.1
I	26,750	85	372	8.7	864.3	864.3	865.0	0.7
J	29,480	60	379	8.5	886.3	886.3	886.8	0.5

[1] Feet above confluence with Russian River

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
RUSSIAN RIVER								
A	0	1,000	25,315	2.4	495.6	495.6	496.4	0.8
B	2,165	2,000	35,767	1.7	496.8	496.8	497.7	0.9
C	3,820	2,700	34,964	1.7	497.5	497.5	498.4	0.9
D	6,850	3,100	32,407	1.6	498.7	498.7	499.6	0.9
E	10,390	2,800	24,445	2.2	499.4	499.4	500.4	1.0
F	11,820	2,800	29,358	1.8	500.1	500.1	501.0	0.9
G	14,635	2,900	20,969	2.5	501.0	501.0	501.9	0.9
H	16,700	2,900	21,330	2.5	502.6	502.6	503.5	0.9
I	19,810	1,850	17,274	3.1	505.6	505.6	506.5	0.9
J	22,910	770	9,369	5.7	508.0	508.0	508.6	0.6
K	25,230	480	5,599	9.5	511.2	511.2	512.1	0.9
L	28,300	880	9,124	5.8	518.2	518.2	518.7	0.5
M	30,645	560	7,835	6.8	522.7	522.7	523.5	0.8
N	33,495	400	6,709	7.2	528.0	528.0	528.9	0.9
O	35,800	450	9,233	5.3	533.3	533.3	533.6	0.3
P	37,665	1,570	18,561	2.6	535.6	535.6	535.9	0.3
Q	40,450	390	3,876	12.5	535.6	535.6	535.9	0.3
R	42,820	430	9,174	5.3	544.0	544.0	545.0	1.0
S	45,310	400	8,619	5.6	546.7	546.7	547.5	0.8
T	48,460	900	14,421	3.4	550.3	550.3	551.0	0.7
U	51,250	1,300	14,328	3.4	552.7	552.7	553.2	0.5
V	53,860	1,320	12,439	3.9	555.5	555.5	556.0	0.5
W	56,770	1,000	11,529	4.2	558.7	558.7	559.3	0.6
X	59,350	1,780	14,876	2.8	561.6	561.6	562.2	0.6
Y	62,815	2,090	19,443	2.2	564.0	564.0	564.7	0.7
Z	67,360	1,970	13,860	3.0	566.6	566.6	567.4	0.8
AA	71,400	2,260	20,590	1.8	572.4	572.4	573.3	0.9

[1] Feet above 50 feet downstream of U.S. Highway 101

TABLE 11	FEDERAL EMERGENCY MANAGEMENT AGENCY MENDOCINO COUNTY, CA AND INCORPORATED AREAS	FLOODWAY DATA RUSSIAN RIVER

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
RUSSIAN RIVER (Continued)								
AB	75,150	2,980	21,124	1.8	577.1	577.1	578.0	0.9
AC	78,980	3,625	23,151	1.6	582.2	582.2	583.2	1.0
AD	81,925	2,500	27,836	1.3	584.8	584.8	585.6	0.8
AE	90,730	1,800	12,150	2.6	595.3	595.3	596.2	0.9
AF	93,020	1,600	11,635	2.7	598.5	598.5	599.1	0.6
AG	98,720	1,000	14,564	5.4	604.8	604.8	605.8	1.0
AH	102,205	400	3,837	7.7	608.9	608.9	609.8	0.9
AI	104,625	400	5,594	4.8	616.4	616.4	616.6	0.2
AJ	106,950	500	5,955	4.0	619.8	619.8	620.5	0.7
AK	108,795	700	6,694	3.3	623.3	623.3	624.0	0.7
AL	111,715	258	3,913	5.5	630.2	630.2	630.7	0.5
AM	113,500	385	4,574	4.7	634.6	634.6	635.5	0.9
AN	117,640	466	6,173	3.1	642.1	642.1	642.6	0.5
AO	119,850	350	4,681	4.1	647.4	647.4	648.1	0.7
AP	123,575	210	3,005	6.4	656.4	656.4	656.9	0.5
AQ	126,100	360	5,722	3.4	661.0	661.0	661.9	0.9
AR	127,595	200	2,406	8.0	663.7	663.7	664.6	0.9
AS	129,620	150	2,478	7.7	671.7	671.7	671.8	0.1
AT	131,615	150	2,914	6.6	678.2	678.2	678.8	0.6
AU	133,780	350	3,203	6.0	682.6	682.6	683.1	0.5
AV	135,880	420	3,637	2.3	692.2	692.2	692.6	0.4
AW	138,300	140	1,760	4.0	695.6	695.6	696.4	0.8
AX	140,955	100	1,295	5.5	708.9	708.9	709.3	0.4
AY	142,250	200	1,803	3.9	713.5	713.5	714.1	0.6

[1] Feet above 50 downstream of U.S. Highway 101

TABLE 11

FEDERAL EMERGENCY MANAGEMENT AGENCY

MENDOCINO COUNTY, CA AND INCORPORATED AREAS

FLOODWAY DATA

RUSSIAN RIVER

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
SULPHUR CREEK								
A	7,636	78	373	4.3	725.2	725.2	726.1	0.9
B	7,756	94	335	4.8	725.8	725.8	726.4	0.6
C	8,060	50	206	7.8	729.3	729.3	730.2	0.9
D	8,168	57	239	6.7	730.3	730.3	731.3	1.0
E	8,354	59	257	6.2	734.0	734.0	734.1	0.1
F	8,447	62	179	9.0	734.5	734.5	734.8	0.3
G	8,470	60	210	7.0	735.4	735.4	735.6	0.2
H	8,963	68	175	9.1	746.9	746.9	746.9	0.0
I	9,355	53	160	10.0	753.4	753.4	753.6	0.2
J	9,634	47	197	8.1	759.2	759.2	759.7	0.5
K	9,842	46	168	9.5	761.3	761.3	761.6	0.3
L	9,858	46	154	10.4	763.9	763.9	763.9	0.0
M	9,954	59	168	9.5	768.5	768.5	768.5	0.0
N	10,029	38	249	6.4	773.8	773.8	773.8	0.0
O	10,212	51	159	10.1	775.4	775.4	775.4	0.0
P	10,307	71	179	9.0	777.7	777.7	777.7	0.0

[1] Feet above confluence with Russian River

TABLE 11

FEDERAL EMERGENCY MANAGEMENT AGENCY

MENDOCINO COUNTY, CA
AND INCORPORATED AREAS

FLOODWAY DATA

SULPHUR CREEK

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
TENMILE CREEK								
A	565[1]	400	2,088	3.3	1,610.9	1,610.9	1,611.8	0.9
B	895[1]	300	1,610	4.3	1,612.0	1,612.0	1,612.6	0.6
C	2,855[1]	250	1,678	4.1	1,617.5	1,617.5	1,618.1	0.6
D	4,210[1]	270	1,799	3.8	1,619.6	1,619.6	1,620.4	0.8
E	5,020[1]	300	2,795	2.5	1,620.3	1,620.3	1,621.2	0.9
TOWN CREEK								
A	240[2]	200	955	2.9	1,382.3	1,382.4	1,383.0	0.7
B	1,085[2]	200	740	3.7	1,387.8	1,387.8	1,388.5	0.7
C	2,750[2]	55	445	6.0	1,397.1	1,397.1	1,397.4	0.8
D	4,185[2]	145	920	3.0	1,402.1	1,402.1	1,402.7	0.6
E	5,140[2]	100	595	4.6	1,406.9	1,406.9	1,407.5	0.6
YORK CREEK								
A	620[3]	55	474	6.9	639.2	634.9[4]	635.3	0.4
B	685[3]	55	590	5.6	639.3	635.1[4]	636.1	1.0
C	1,655[3]	80	673	4.9	641.5	641.5	642.5	1.0
D	3,300[3]	120	968	3.4	645.1	645.1	646.0	0.9
E	4,700[3]	70	513	6.4	650.7	650.7	650.9	0.2
F	7,225[3]	90	587	5.6	664.4	664.4	664.8	0.4
G	9,925[3]	110	665	3.6	680.2	680.2	680.9	0.7
H	12,955[3]	90	619	3.9	698.7	698.7	699.4	0.7

[1] Feet above 0.2 mile downstream of Branscomb Road
[2] Feet above confluence with Grist Creek
[3] Feet above confluence with Russian River
[4] Elevation computed without consideration of flooding controlled by Russian River

TABLE 11

FEDERAL EMERGENCY MANAGEMENT AGENCY

MENDOCINO COUNTY, CA AND INCORPORATED AREAS

FLOODWAY DATA

TENMILE CREEK - TOWN CREEK - YORK CREEK

Encroachment into areas subject to inundation by floodwaters having hazardous velocities aggravates the risk of flood damage and heightens potential flood hazards by further increasing velocities. A listing of stream velocities at selected cross sections is provided in Table 11, “Floodway Data”. To reduce the risk of property damage in areas where the stream velocities are high, the community may wish to restrict development in areas outside the floodway.

The common floodway for Broaddus Creek, Davis Creek, Haehl/Baechtel Creek, and Mill Creek (at Willits), in Mendocino County were not determined in the two dimensional FESWMS model. The floodway for this area was determined as an administration floodway by using the effective floodway. However, the floodway data and cross-sections are not presented in Table 11, “Floodway Data”.

Along streams where floodways have not been computed, the community must ensure that the cumulative effect of development in the floodplains will not cause more than a 1.0-foot increase in the BFEs at any point within the county.

Near the mouths of streams studied in detail, floodway computations are made without regard to flood elevations on the receiving water body. Therefore “Without Floodway” elevations presented in Table 11, “Floodway Data”. for certain downstream cross-sections of Ackerman Creek, Feliz Creek, Gibson Creek, Hensley Creek, Orrs Creek, and York Creek are lower than regulatory floodway elevations in that area, which must take into account the 1-percent annual chance flooding due to backwater from other sources such as the Russian River.

Due to the complex hydraulics of Noyo Harbor, no floodways were computed for the Noyo River.

The area between the floodway and 1-percent-annual-chance floodplain boundaries is termed the floodway fringe. The floodway fringe encompasses the portion of the floodplain that could be completely obstructed without increasing the water-surface elevation of the 1-percent-annual-chance flood more than 1 foot at any point. Typical relationships between the floodway and the floodway fringe and their significance to floodplain development are shown in Figure 3, “Floodway Schematic”.

For the remaining communities in Mendocino County, the floodways for this study were determined using Methods 1 and Method 6 encroachment analyses of the USACE HEC-2 computer program (USACE, August 1979). No encroachment was attempted for cross sections at bridges. Encroachment limits were based on equal-conveyance reduction which would produce a surcharge in water surface related to a corresponding maximum 1.0-foot surcharge in energy grade line or water-surface elevation. Because of the effects of downstream encroachment on energy grade line and water-surface elevations upstream, there may be numerous cross sections where minimal encroachment can be permitted.

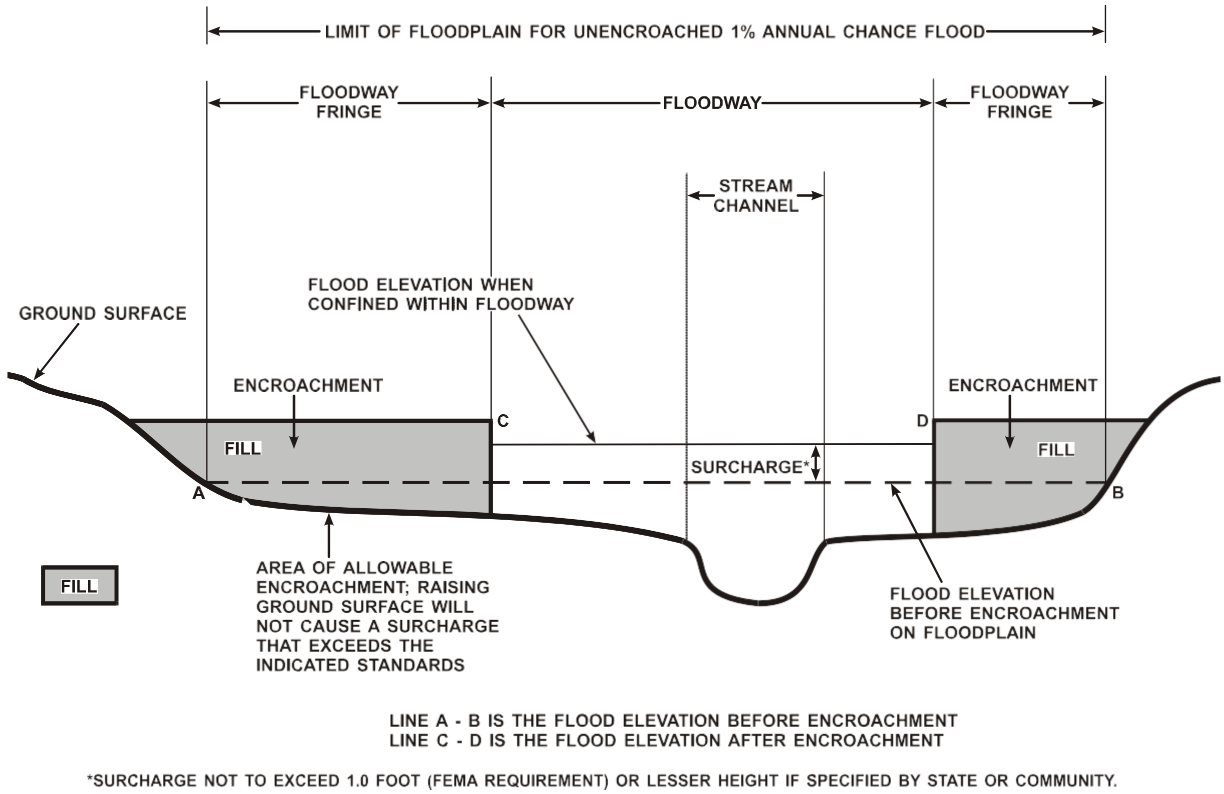

Figure 3 – Floodway Schematic

As an example, encroachment under certain flow conditions can result in a localized lowering of the water-surface elevation and an increase in velocity. However, this increase in velocity usually results in an increase in water-surface elevation at some point upstream. Encroachment at some cross sections must therefore be limited so that rises greater than 1 foot in either the water-surface elevation or energy grade line do not result at upstream cross sections.

5.0 INSURANCE APPLICATIONS

For flood insurance rating purposes, flood insurance zone designations are assigned to a community based on the results of the engineering analyses. The zones are as follows:

Zone A

Zone A is the flood insurance rate zone that corresponds to the 1-percent-annual-chance floodplains that are determined in the FIS report by approximate methods. Because detailed hydraulic analyses are not performed for such areas, no BFEs or depths are shown within this zone.

Zone AE

Zone AE is the flood insurance rate zone that corresponds to the 1-percent-annual-chance floodplains that are determined in the FIS report by detailed methods. Whole-foot BFEs derived from the detailed hydraulic analyses are shown at selected intervals within this zone.

Zone V

Zone V is the flood insurance rate zone that corresponds to the 1-percent-annual-chance coastal floodplains that have additional hazards associated with storm waves. Because approximate hydraulic analyses are performed for such areas, no BFEs are shown within this zone.

Zone VE

Zone VE is the flood insurance rate zone that corresponds to the 1-percent-annual-chance coastal floodplains that have additional hazards associated with storm waves. Whole-foot BFEs derived from the detailed hydraulic analyses are shown at selected intervals within this zone.

Zone X

Zone X is the flood insurance rate zone that corresponds to areas outside the 0.2-percent-annual-chance floodplain, areas within the 0.2-percent-annual-chance floodplain, areas of 1-percent-annual-chance flooding where average depths are less than 1 foot, areas of 1-percent-annual-chance flooding where the contributing drainage area is less than 1 square mile (sq. mi.), and areas protected from the base flood by levees. No BFEs or depths are shown within this zone.

Zone D

Zone D is the flood insurance rate zone that corresponds to unstudied areas where flood hazards are undetermined, but possible.

6.0 FLOOD INSURANCE RATE MAP

The FIRM is designed for flood insurance and floodplain management applications.

For flood insurance applications, the map designates flood insurance risk zones as described in Section 5.0 and, in the 1-percent-annual-chance floodplains that were studied by detailed methods, shows selected whole-foot BFEs or average depths. Insurance agents use the zones and BFEs in conjunction with information on structures and their contents to assign premium rates for flood insurance policies.

For floodplain management applications, the map shows by tints, screens, and symbols, the 1- and 0.2-percent-annual-chance floodplains, floodways, and the locations of selected cross sections used in the hydraulic analyses and floodway computations.

The countywide FIRM presents flooding information for the geographic area of Mendocino County, California. Previously, FIRMs were prepared for each incorporated community of the County identified as flood-prone. This countywide FIRM also includes flood hazard information that was presented separately on Flood Boundary and Floodway Maps (FBFMs), where applicable. Historical data relating to the maps prepared for each community are presented in Table 12, "Community Map History."

7.0 OTHER STUDIES

This FIS report either supersedes or is compatible with all previous studies published on streams studied in this report and should be considered authoritative for the purposes of the NFIP (FEMA, August 1985; FEMA, June 1986; FEMA, September 1988 (a); FEMA, June 1992 (a); FEMA, June 1992 (b); and FEMA, September 2005).

Flood and floodway data presented are not in agreement with the FIS currently in production for Humboldt, Sonoma, and Trinity Counties.

The Humboldt FIS does not include coastal flooding zones, while Mendocino County does shown coastal flooding. (FEMA, Unpublished (a)).

In Sonoma County, the Russian River and Gualala River are studied in detail, while in Mendocino County only approximate studies were done. Also, the Sonoma County FIS, effective 10/2/15, will have a coastal flooding zones included in the study.

In Trinity County, the North Fork Eel River and Hull Valley Creek were both studied by approximate methods. In Mendocino County, these areas are not studied by either approximate or detailed methods. These areas are shown to be in Zone X or Zone D. (FEMA, Unpublished (c)).

8.0 LOCATION OF DATA

Information concerning the pertinent data used in the preparation of this FIS can be obtained by contacting:

FEMA, Federal Insurance and Mitigation Division
1111 Broadway, Suite 1200
Oakland, California 94607-4052.

COMMUNITY NAME	INITIAL IDENTIFICATION	FLOOD HAZARD BOUNDARY MAP REVISION DATE (S)	FLOOD INSURANCE RATE MAP EFFECTIVE DATE	FLOOD INSURANCE RATE MAP REVISION DATE (S)
Fort Bragg, City of	May 10, 1974	October 3, 1975	December 7, 1982	June 16, 1992 June 2, 2011
Mendocino County (Unincorporated Areas)	January 3, 1974	April 25, 1978	June 1, 1983	June 3, 1986 September 30, 1988 June 16, 1992 June 2, 2011
Pinoleville Indian Reservation	June 2, 2011	None	June 2, 2011	--
Point Arena, City of	October 18, 1974	December 26, 1975	August 3, 1984	June 3, 1986 June 2, 2011
Ukiah, City of	August 9, 1974	September 17, 1976 January 3, 1978 June 6, 1978	July 19, 1982	August 5, 1985 June 2, 2011
Willits, City of	February 8, 1974	July 30, 1976	July 19, 1982	September 30, 1988 June 2, 2011

TABLE 12

FEDERAL EMERGENCY MANAGEMENT AGENCY

MENDOCINO COUNTY, CA AND INCORPORATED AREAS

COMMUNITY MAP HISTORY

9.0 BIBLIOGRAPHY AND REFERENCES

Airborne 1 Corporation, LiDAR provider. March 2010.

CH2M HILL, Inc., Russian River Bridge on Vichy Springs Road Drainage Study, Redding, California, February 1979

CH2MHILL, 2006. Willits Bypass Floodplain Evaluation Report. California Department of Transportation, North Region – Division of Design and Engineering Services, Salt Lake City, UT.

Dobson, R.S., A Program to Construct Refraction Diagrams and Compute Wave Heights for Waves Moving into Shoaling Waters, Stanford University, March 1967

Federal Emergency Management Agency, Digital Flood Insurance Rate Map Database, Mendocino County, California, and Incorporated Areas. Washington, D.C., June 2, 2011.

Federal Emergency Management Agency, Federal Insurance Administration, Flood Insurance Rate Map, City of Fort Bragg, Mendocino County, California, Scale 1:9,600, December 7, 1982

Federal Emergency Management Agency, Flood Insurance Rate Map, City of Point Arena, California, August 3, 1984

Federal Emergency Management Agency, Flood Insurance Study, City of Ukiah, Mendocino County, California, August 5, 1985

Federal Emergency Management Agency, Flood Insurance Study, City of Point Arena, Mendocino County, California, June 3, 1986

Federal Emergency Management Agency, Flood Insurance Study, City of Willits, Mendocino County, California, September 30, 1988 (a)

Federal Emergency Management Agency, Flood Insurance Study, Mendocino County, California (Unincorporated Areas), September 30, 1988 (b)

Federal Emergency Management Agency, Flood Insurance Study, City of Fort Bragg, Mendocino County, California, June 16, 1992 (a)

Federal Emergency Management Agency, Flood Insurance Study, Mendocino County, California, (Unincorporated Areas), September 30, 1988, Revised June 16, 1992 (b)

Federal Emergency Management Agency, Flood Insurance Study, Lake County and Incorporated Areas, California, September 30, 2005

Federal Emergency Management Agency, Flood Insurance Study, Humboldt County and Incorporated Areas, California, Unpublished (a)

Federal Emergency Management Agency, Flood Insurance Study, Sonoma County and Incorporated Areas, California, Unpublished (b)

Federal Emergency Management Agency, Flood Insurance Study, Trinity County and Incorporated Areas, California, Unpublished (c)

Felton, E.L., California's Many Climates, Pacific Books, Palo Alto, California, 1965

Fry, J., Xian, G., Jin, S., Dewitz, J., Homer, C., Yang, L., Barnes, C., Herold, N., and Wickham, J., 2011. Completion of the 2006 National Land Cover Database for the Conterminous United States, PE&RS, Vol. 77(9):858-864

Hunt, I.J., "Design of Seawalls and Breakwaters," Proceedings of the ASCE, Vol. 85, No. WW3, 1959

Mendocino County, County Zoning Regulations, Section 20-71, Supplied by Planning Department, Ukiah, California, n.d.

Meteorology International, Inc., Deep-Water Wave Statistics for the California Coast, prepared for the California Department of Boating and Waterways, n.d.

Natural Resources Conservatoin Service, Urban Hydrology for Small Watersheds TR-55, June 1986.

Noyo Port District, Noyo Harbor District, "Request for Proposal Waterfront Restoration Plan," May 17, 1989

Ott Water Engineers, Inc., Aerial Photography, Scale 1:4,800, Contour Interval of 4 feet, 1983 (a)

Ott Water Engineers, Inc., Aerial Photography, Scale 1:4,800, Contour Interval 4 feet: point Arena Cove, California, 1983 (b)

Ott Water Engineers, Inc., Northern California Coastal Flood Studies, prepared for the Federal Emergency Management Agency, August 1984

Pacific Gas and Electric, Telephone Communication, Paul Land, San Francisco, California, April 1979

Pagenkopf, James R., et. al., A Two-Dimensional Finite Element Circulation Model, A User's Manual for CAFE-1, R.M. Parsons Laboratory, M.I.T., August 1976, with modification made by Ott Water Engineers, Inc.

Philip Williams and Associates, Ltd., Work Map, Flood Insurance Study, Noyo

River, Mendocino County, California, scale 1:2,400, Contour Interval 2 feet, October 31, 1990

State of California, Department of Water Resources, Bulletin 161, Flood! December 1964 - January 1965, Sacramento, California, January 1965

Towill Corporation,, Contour Map of Select Areas of Mendocino County, Scale 1:4,800, Contour Interval 5 feet, San Francisco, California, September 1979 (a)

Towill Corporation, Contour Map of the City of Ukiah, Scale 1:4,800, Contour Interval 5 feet, San Francisco, California, September 1979 (b)

Towill Corporation, Contour Map of the City of Willits, Scale 1:4800, Contour Interval 5 feet, San Francisco, California, September 1979 (c)

U.S. Census Bureau, State and County Quick Facts, http://quickfacts.census.gov/qfd/states/06/06045.html, accessed July 6, 2015

U.S. Department of Agriculture, Farm Services Agency Photogrpahy Field Office, 2014 National Agriculture Imagery Program Mosaic, Salt Lake City, UT, 2014

U.S. Department of the Army, Corps of Engineers, San Francisco District, Reservoir Regulation Manual - Coyote Dam, San Francisco, California, n.d. (a)

U.S. Department of the Army, Corps of Engineers, San Francisco District, High Water Mark Data for Eel River, Flood of December 1964, San Francisco, California, n.d. (b)

U.S. Department of the Army, Corps of Engineers, San Francisco District, High-Water-Mark Data for Russian River Flood of December 1964, San Francisco, California, n.d. (c)

U.S. Department of the Army, Corps of Engineers, San Francisco District, Report of Floods of December 1955 and January 1956 in Northern California Coastal Streams, San Francisco, California, June 1956

U.S. Department of the Army, Corps of Engineers, Inspection of Northwestern California Disaster Area, by Special Subcommittee on Flood Disasters, Committee on Public Works, U.S. House of Representatives, San Francisco, California, January 10-12, 1965

U.S. Department of the Army, Corps of Engineers, San Francisco District, Report on Floods of December 1964 in Northern California Coastal Streams, Volume III, Flood Plains on the Eel River, Northern California Coastal Streams, and the Russian River, San Francisco, California, December 1965

U.S. Department of the Army, Corps of Engineers, Waterway Experiment Station, Technical Report H-74-3, Flood Insurance Study: Tsunami Prediction for Pacific Coastal Communities, J.R. Houston and A.W. Garcia, May 1974

U.S. Department of the Army, Corps of Engineers, Galveston District, Guidelines for Identifying Coastal High Hazard Zones, June 1975

U.S. Department of the Army, Office of the Chief of Engineers, "Final Environmental statement, Maintenance Dredging, Noyo River Channel, Noyo Harbor, Mendocino County, California," August 1975

U.S. Department of the Army, Corps of Engineers, Shore Protection Manual, 1977

U.S. Department of the Army, Corps of Engineers, California Coast Storm Damage, Winter 1977-1978, G.W. Domurat, 1978

U.S. Department of the Army, Corps of Engineers, Coastal Engineering Research Center, Technical Aid No. 78-2, Revised Wave Run-up Curves for Smooth Slopes, P.N. Stoa, July 1978

U.S. Department of the Army, Corps of Engineers, Waterway Experiment Station, Technical Report H-78-26, Flood Insurance Study: Tsunami Prediction for the West Coast of the Continental United States, J.R. Houston and A.W. Garcia, December 1978

U.S. Department of the Army, Corps of Engineers, Waterway Experiment Station, Technical Report HL-79-2, A Numerical Model for Tsunami Inundation, J.R. Houston and H.L. Butler, February 1979

U.S. Department of the Army, Corps of Engineers, Hydrologic Engineering Center, HEC-2 Water-Surface Profiles, Users Manual, Davis, California, August 1979

U.S. Department of Commerce, National Climatic Data Center, Meteorological Record for San Francisco, California, Airport, Asheville, North Carolina, 1944-1983

U.S. Department of Commerce, National Climatic Data Center, Three- Hourly North American Surface Weather Maps, Asheville, North Carolina, 1955-1983

U.S. Department of Commerce, National Oceanic and Atmospheric Administration, Tide Tables, High and Low Water Predictions, West Coast of North and South America, 1945-1983

U.S. Department of Commerce, National Ocean Survey, Tidal Datums and Information Branch, Tides and Water Levels Division, Summary of Extreme Water Levels for San Francisco, Point Reyes, Arena Cove, and Crescent City, n.d.

U.S. Department of Commerce, Tiger/Line Shapefile, 2014, Washington D.C., 2014

U.S. Department of Housing and Urban Development, Federal Insurance Administration, Flood Hazard Boundary Map, City of Willits, Mendocino County, California, Scale 1:9600, July 1976

U.S. Department of Housing and Urban Development, Federal Insurance Administration, Flood Hazard Boundary Map, Mendocino County, California (Unincorporated Areas), April 25, 1978

U.S. Department of the Interior, Geological Survey, 15-Minute Series Topographic Maps, Scale 1:62,500, Contour Interval 80 feet: Ukiah, California, 1958

U.S. Department of the Interior, Geological Survey, 15-Minute Series Topographic Maps, Scale 1:62,500, Contour Interval 80 feet: Willits, California, 1961

U.S. Department of the Interior, Geological Survey, Water-Supply Paper 1866, Floods of December 1964 and January 1965 Far Western States, 1969

U.S. Department of the Interior, Geologic Survey, National Streamflow Statistics Program. 2010.

.

U.S. Department of the Interior, Geological Survey, Technical Memorandum, Supplementary Guidelines for Flood Discharge Computation in HUD Type-15 Studies, May 5, 1975

U.S. Department of the Interior, Geological Survey, Water-Resources Investigations 77-21, Magnitude and Frequency of Floods in California, A.O. Waananen and J.R. Crippen, Menlo Park, California, June 1977

U.S. Water Resources Council, Bulletin 17A, "Guidelines for Determining Flood Flow Frequency," June 1977

Winsler and Kelly Consulting Engineers, Humboldt County Water Requirements and Water Resources, Phase 1, prepared for Humboldt County Board of Supervisors, Eureka, California, May 1970

10.0 REVISION DESCRIPTIONS

This section has been added to provide information regarding significant revisions made since the first countywide FIS was printed. Future revisions may be made that do not result in the republishing of the FIS report. To assure that any user is aware of all revisions, it is advisable to contact the appropriate community repository of flood-hazard data as listed on the Flood Insurance Rate Map Index.

10.1 First Revision (Revised Month XX, XXXX)

This revision is dated Month XX, XXXX. The City of Willits was previously selected for the countywide revision under Map-IX. However, a one-dimensional, steady state flow modeling approach in the alluvial valley where channels are small and shallow had poor results in overbank flow, split flow, and flood volume. Therefore, the results of the one-dimensional modeling were not included in the countywides Mendocino County map updates. The area was subsequently remodeled and revised by the FEMA Mapping Partner, California Department of Water Resources (DWR), under Mapping Activity Statement No.7 (MAS 7). MAS 7 called for the preparation of a physical map revision (PMR) for the City of Willits, in addition to the Calaveras County PMR and Trinity County East Weaver Levee PMR.

<u>City of Willits Floodplain Mapping</u>

The City of Willits Floodplain Mapping Study, conducted by DWR, encompasses the City of Willits, Mendocino County, California, on the southwest corner of the Little Lake Valley. The streams included in the modeling for this study are Mill Creek (at Willits), Broaddus Creek, Baechtel Creek, Davis Creek, an Overland Flow which is a tributary of Davis Creek, Scout Creek, and Berry Creek and its tributary. The Little Lake Valley watershed occupies approximately 67.5 square miles Mendocino County.

The topographic LiDAR data was collected by Airborne-1 in early 2010. The LiDAR contractor performed quality checks to ensure the LiDAR data met accuracy requirements (Airborne 1 Corporation, 2010).

The most recent hydrologic modeling for the area was the previous effective HEC-HMS rainfall run-off model performed by CH2MHILL in 2006 (CHM2HILL, 2006). The revised hydrologic modeling for this study was performed by DWR with the National Streamflow Statistics (NSS) program (USGS, 2010) The two-dimensional hydraulic models required flow hydrographs as an input. The NSS program contains a procedure that computes a hydrograph that represents average runoff for specific peak discharge. In order to compute the hydrograph, the peak discharge for the hydrograph, the basin lag time, and dimensionless-hydrograph ordinates must be supplied. Peak discharge can be calculated from the drainage area and mean annual precipitation. The NSS program computed 2-year to 500-year peak flows but only the 100-year and 500-year flows were applied in the hydraulic model. Table 13, "NSS Computed 100- and 500- Year Peak Flows", provides the summary of peak flow from the NSS program.

Table 13: NSS Computed Peak Flows

Stream/ Tributary	Drainage Area (square miles)	Mean Annual Precipitation (inches)	1% Annual Chance (cfs)	0.2% Annual Chance (cfs)
Baechtel Creek	9.66	56.9	3,270	4,260
Berry Creek	3.00	45.0	1,040	1,380
Broaddus Creek	7.79	56.7	2,710	3,530
Davis Creek	14.30	45.0	4,030	5,300
Haehl Creek	5.69	49.5	1,910	2,520
Mill Creek	9.45	55.0	3,150	4,110
Overland Flow	2.00	45.0	734	977
Scout Lake Creek	1.89	45.0	699	930
Trib. to Berry Creek	1.76	45.0	657	875

The basin lag time was estimated as sixty percent of the time of concentration according to the NRCS TR-55 manual (NRCS, 1986). Table 14, “Estimated Lag Times”, shows the estimated lag times for the streams flowing into the valley based on the CH2MHILL HEC-HMS model (CH2MHILL, 2006).

Table 14: Estimated Lag Times

Stream/Tributary	Time of Concentration (mins)	Hydrograph Lag Time (mins)	Time of Concentration (hrs)	Hydrograph Lag Time (hrs)
Baechtel Creek	202.8	121.6	8.45	5.07
Berry Creek	62.4	37.4	2.6	1.56
Broaddus Creek	219	131.4	9.13	5.48
Davis Creek	202.8	121.6	8.45	5.07
Haehl Creek	175.8	105.4	7.33	4.39
Mill Creek	198.6	119.1	8.28	4.96
Overland Flow	62.4	37.4	2.6	1.56*
Scout Lake Creek	62.4	37.4	2.6	1.56*
Trib. to Berry Creek	62.4	37.4	2.6	1.56*

* indicates estimated values based on the lag time of Berry Creek

The dimensionless ordinates of the hydrograph are stored within the NSS program. Once a hydrograph is developed for each stream, each stream flow hydrograph was input into the two-dimensional model and flow routed through the valley for estimating flood depth, water surface elevation, and velocity at each of the model grid.

Revised hydraulic analyses were performed by DWR. After one-dimensional hydraulic modeling was proven insufficient, two-dimensional hydraulic modeling was performed with FLO-2D. The same one-dimensional streams that were previously studied in HEC RAS were included in the two-dimensional modeling. Therefore, DWR converted the projection and datum of the terrain to the NAD State Plane California Zone II coordinate system, Federal Information Processing Standard (FIPS) Zone 0402 NAVD 88, and redefined horizontal and vertical units to feet to match that of the HEC RAS projection and datum. The FLO-2D primer tool created cell grids and assigned hydraulic parameters within the model boundary. 50-feet grid cells were created for two-dimensional modeling to mimic the stream channels and profiles. N-values were assigned using the National Land Cover Database 2006 nationwide grid (NLCD, 2006). Nine inflow hydrographs were input as upstream boundary conditions in the FLO-2D model and a single downstream boundary condition was set at the basin outlet using normal slope. Once all the parameters were set, test simulations were performed to ensure that the tail end of the hydrograph reached the downstream end of the basin. The final results include a 1% Annual Chance and 0.2% Annual Chance simulations with maximum water surface elevation, flood depths, and flood velocity.

This FIS revision also incorporates the determinations of letters issued by FEMA resulting in map changes (Letter of Map Revisions [LOMR]), as shown in Table 15, "Letters of Map Revision."

Table 15: Incorporated Letters of Map Revision

Communities Affected	Flooding Source(s)	Effective Date	Case Number
Mendocino County	N/A	N/A	N/A
Willits, City of	N/A	N/A	N/A